Panasonic

KW7M
Eco-POWER METER
User's Manual

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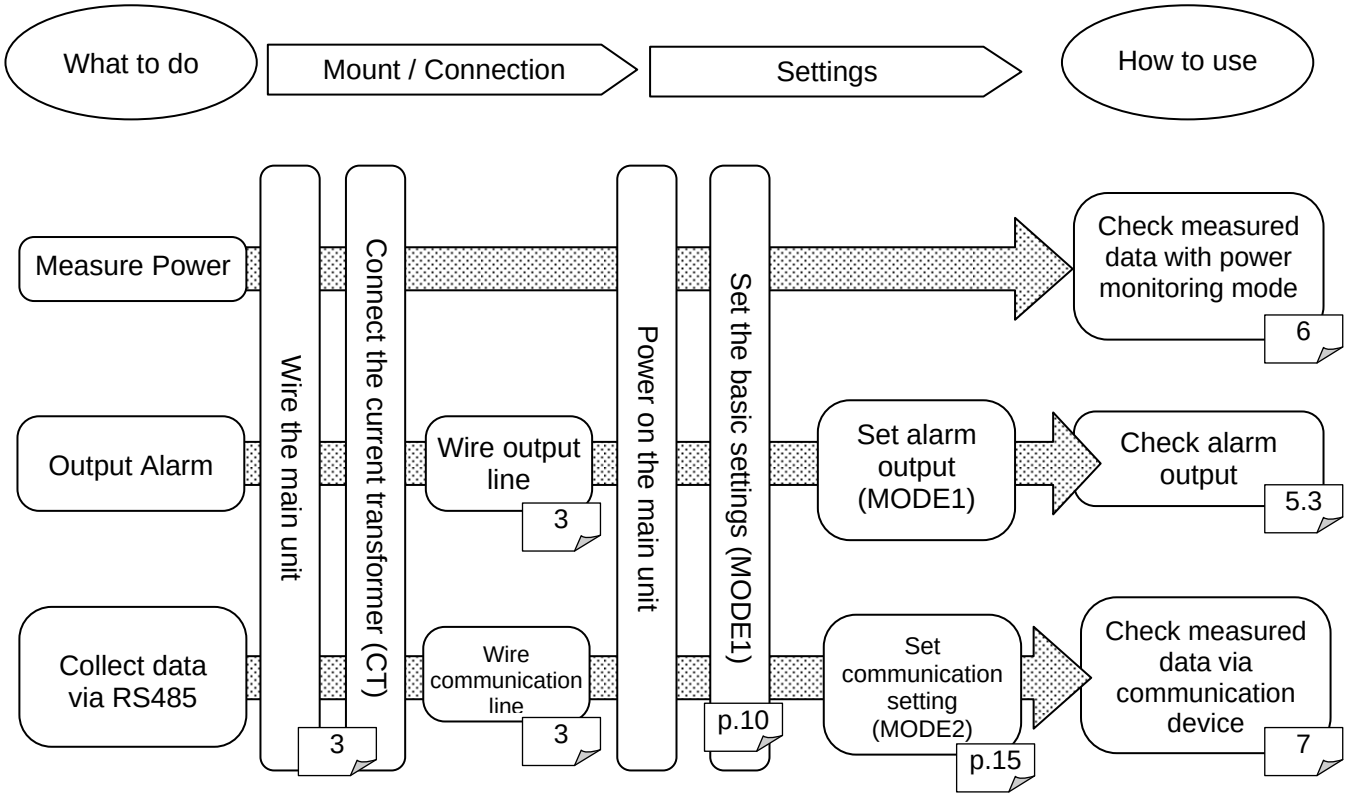
Basic setting to measure by Eco-POWER METER

When wiring the main unit and the current transformer (CT) and setting the mode 1 after power on, you can measure the power
In order to use the other functions, the settings of the each parameter are necessary.



Cautions for Your Safety

Read the manual carefully before installing, running and maintenance for proper operation.

Before using, master the knowledge of the equipment, safety information and all of other notes.

This manual uses two safety flags to indicate different levels of danger.

WARNING A handling error could cause serious physical injury to an operator and in the worst case could even be fatal.

- Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.
- Do not use this product in areas with inflammable gas. It could lead to an explosion.
- Exposing this product to excessive heat or open flames could cause damage to the lithium battery or other electronic parts.

CAUTION A handling error could cause serious physical injury to an operator or damage to the equipment.

- To prevent abnormal exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assured in these specifications.
- Do not dismantle or remodel the product. It could lead to abnormal exothermic heat or smoke generation.
- Do not touch the terminal while turning on electricity. It could lead to an electric shock.
- Use the external devices to function the emergency stop and interlock circuit.
- Connect the wires or connectors securely. The loose connection might cause abnormal exothermic heat or smoke generation.
- Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It might cause exothermic heat or smoke generation.
- Do not undertake construction (such as connection and disconnection) while the power supply is on.
- Do not use at secondary side circuit of inverter. It might cause exothermic heat or damage.

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Introduction

Thank you very much indeed for purchasing “KW7M Eco-POWER METER”.
In this manual, we explain the usage of “KW7M Eco-POWER METER” in detail.
Please use it correctly after understanding the content enough.

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Cautions before using

■ Installation environment

◇Do not use the Unit in the following environments.

- ・Where the unit will be exposed to direct sunlight and where the ambient temperature is outside the range of -10 to 50 °C.
- ・Where the ambient humidity is outside the range of 30 to 85 % RH (at 20℃ non-condensing) and where condensation might occur by sudden temperature changes
- ・Where inflammable or corrosive gas might be produced
- ・Where the unit will be exposed to excessive airborne dust or metal particles
- ・Where the unit will be exposed to water, oil or chemicals
- ・Where organic solvents such as benzene, paint thinner, alcohol, or strong alkaline solutions such as ammonia or caustic soda might adhere to the product
- ・Where direct vibration or shock might be transmitted to the product, and where water might wet the product
- ・Where the place near high-voltage cable, high-voltage device, power line, power device.
- ・Where the place near a machinery with transmission function such as amateur radio.
- ・Where the place near a machinery which occurs the big switching serge

◇Please use the Unit according to the specifications described in this manual. Otherwise, it may malfunction or cause fire and an electric shock.

- ・Connect to the power supply in compliance with the rating.
- ・Refer to the wiring diagram to ensure proper wiring for the power supply, input and output.
- ・Do not perform wiring or installation with a live line. It may also lead to circuit burnout or fire by way of the secondary CT side opening.

■ Installation

- ・Installation and wiring must be performed by expert personnel for electrical work or electric piping.
- ・The power supply terminal and voltage input terminal of the main unit is common. Therefore if additional noise effects the power supply line, incorrect measurements may result.
- ・Eco-POWER METER is designed to be used in a control panel.

■ As to Measurement

- ・If there is some distortion by harmonic or waveform, it may not measure correctly. Please check with the actual system before adopting it.
- ・This can't measure the power that flows reverse such as a regenerative electric power. If you measure a reverse power, it shows "0.00kW" and it doesn't count.
- ・It might not measure an instantaneous current such as an inrush current or an welding machine.
- ・When measuring the below loads, it might not satisfy with the accuracy guarantee.
  Out of rating current, Load with low power factor,
  Load with winding current, Load with ferromagnetic field

■ Static electricity

- ・Discharge static electricity touching the grounded metal etc. when you touch the unit.
- ・Excessive static electricity might be generated especially in a dry place.

■ Cleaning

- ・Wipe dirt of the main unit with soft cloth etc. When thinner is used, the unit might deform or be discolored.

■ Power supply

・Connect a breaker to the voltage input part for safety reasons and to protect the device.
The breaker that connects to the voltage input part must arrange at the position easily reached, and display shows it is the breaker of the equipment.

・Do not turn on the power supply or input until all wiring is completed.

■ Before power on

Please note the following points when turning on power at the first time.

・Confirm there are neither wiring rubbish nor especially an electrical conduction when installed.

・Confirm neither the power supply wiring, the I/O wiring nor the power-supply voltage are wrong.

・Tighten the installation screw and the terminal screw surely.

・Use an electric wire applicable to the rated current.

Chapter 1 Unit's Features and Structure

1.1 Features

■KW7M Eco-POWER METER is a watt-meter of DIN rail installation type. Electric power, voltage, current, etc. are measured using AC voltage and AC current input via one of the following systems.

■**Eco-POWER METER is designed chiefly to manage saving energy. It is neither intended nor can it be legally used for billing.**

1.2 Unit's Name and Model Numbers

1.2.1 Main unit

Phase and Wire system	Rated input	Current transformer	Terminal type	Model No.
Single-phase two-wire system Single-phase three-wire system Three-phase three-wire system	100 / 200V AC	Dedicated CT type	Screw terminal	AKW7111

1.2.2 Option

Dedicated Current Transformer (CT) Clamp-on type

Product name	Rated primary current	Model No
Dedicated current transformer for 5A/50A	5A / 50A	AKW4801C
Dedicated current transformer for 100A	100A	AKW4802C
Dedicated current transformer for 250A	250A	AKW4803C
Dedicated current transformer for 400A	400A	AKW4804C

Dedicated Current Transformer (CT) Through type

Product name	Rated primary current	Model No
Dedicated current transformer for 50A/100A	50A / 100A	AKW4506C
Dedicated current transformer for 250A/400A	250A / 400A	AKW4507C

Others

Product name	Contents	Model No.
Mounting rails	DIN rail	AT8-DLA1
Mounting plate	Use to fix to DIN rail	ATA4806
Terminal screw driver	Using when wiring Phoenix terminal	AFP0806

1.3 Measurement items

Item		Unit	Data range
Instantaneous electric power		kW	0.00 to 999999.99
Integral electric power		kWh	0.00 to 9999999.9
Current	L1(CT1)-phase current	A	0.0 to 6000
	L2(CT2)-phase current		
Voltage	Voltage between 1-2	V	0.0 to 9999
	Voltage between 2-3		
Electricity charge ※			0.00 to 99999999

※Eco-POWER METER is designed chiefly to manage saving energy.
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Chapter 2 Parts Name and Working

2.1 Parts Names

①Display indicator ・Lighting or Blinking according to the display

②LOCK indicator ・Lighting while in lock mode

③T/R indicator ・Blinking while communication

④OUT indicator ・Lighting when pulse output

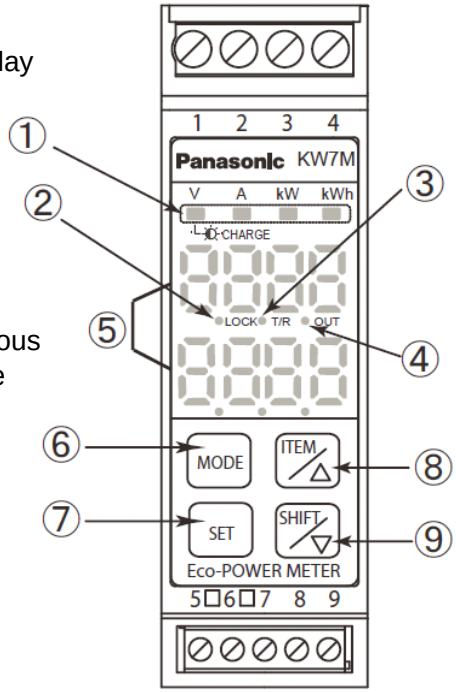
⑤Display each value ・Display Electric energy, Instantaneous power, Current, Voltage, Electricity charge
・Display each setting value

⑥MODE Key

⑦SET Key

⑧ITEM / △ Key

⑨SHIFT / ▽ Key



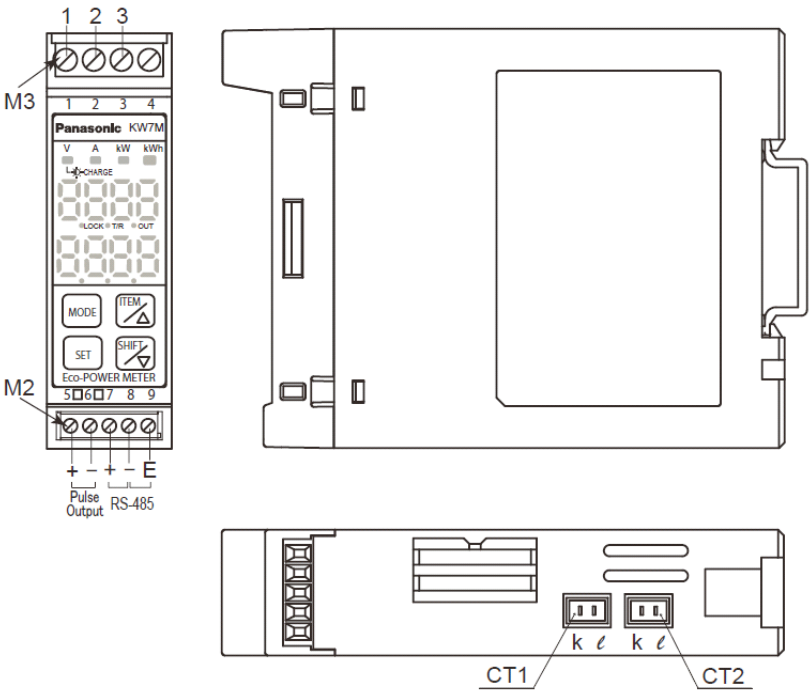
2.2 Keys' Functions

Key	Functions
<MODE>	・Use to select mode
<SET>	・Use to set each value entered
<ITEM/ △>	・To select measured display ・To shift each mode ・To change each setting value
<SHIFT/ ▽>	・To select measured display ・To shift each mode ・To change each setting value
<SET>+<MODE>	・Reset the measured value
<SET> (continuous press about 3-sec)	・All keys locked ・Release lock mode while in lock mode

Chapter 3 Wiring

3.1 Main unit terminal arrangement

Be sure to wire correctly according to the terminal arrangement and wiring diagrams.



No.	Functions		
1	1, R, R	Power supply (common)	Measured voltage input
2	2, N, S		
3	3, T, T		
4	No connection (N.C.)		
5	+	Pulse output	
6	−		
7	+	RS-485	
8	−		
9	E		

⚠ **The input voltage to each terminal is as follows.**

Phase and wire	Terminal	Input voltage
Single-phase, two-wire	1－2	100-120/200-240VAC (100-120/200-240V～)
Single-phase, three-wire	1－2－3	100-120VAC (100-120V～:3W)
Three-phase, three-wire	1－2－3	100-240VAC (200-240V 3～)

Caution for Wiring

1) Terminal fastening torque should be **0.5 to 0.6 N·m** for No.1 to No.4 (M3 screw) and **0.22 to 0.25 N·m** for No.5 to No.9 (M2 screw).
2) Use wire with its cross section of 0.14~1.5mm^2(AWG#26~14) for voltage input terminal (No.1, 2, 3), use wire with its cross section of 0.14~1.0mm^2(AWG#26~16) for pulse output terminal (No.5, 6), use wire with its cross section of 0.3~1.0mm2(AWG#22~16) for communication terminal (No.7, 8, 9). When connecting 2 or more wires to communication terminal, use same wire with its cross section of 0.3 to 0.34mm^2.
3) This has no built-in power switch, circuit breaker or fuse. Therefore it is necessary to install them in the circuit near this unit.
(Recommended fuse: Time-lag fuse, rated voltage 250V AC, rated current 2A)
4) We recommend the below ferrules (terminals) for wiring.
(We don't recommend them when 2 or more wires are connected.)

Terminal No.	Product number for Ferrule (PHOENIX CONTACT)
No.1 to No.4 (M3 screw)	AI 0.25-8YE AI 0.34-8TQ AI 0.5-8WH AI 0.75-8GY AI 1.0-8RD AI 1.5-8BK
No.5 to No.9 (M2 screw) (When 1 wire is connected.)	AI 0.25-8YE AI 0.34-8TQ AI 0.5-8WH

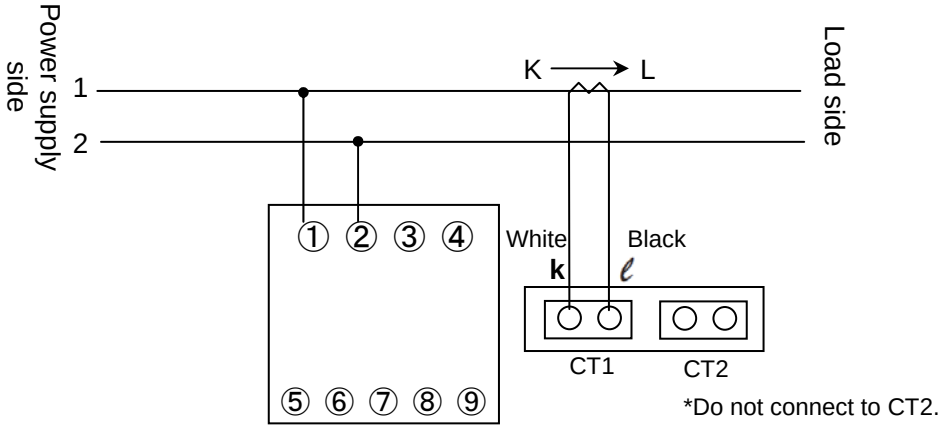
5) Use flame-resistant cable for each wiring.

3.2 Wiring Diagrams

Please connect a breaker (3 to 15A) to the voltage input part for safety reasons and to protect the device. Grounding the secondary side of VT (Voltage transformer) and CT (Current transformer) is not necessary with low-voltage circuit.

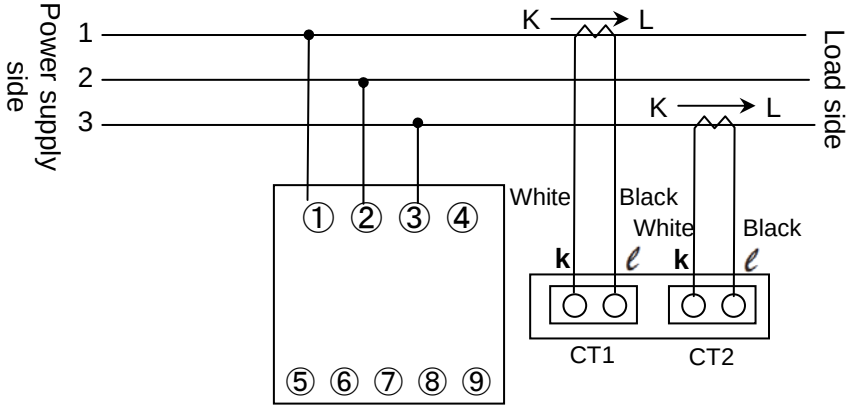
◆When measuring a load with rated input voltage

Single-phase two-wire system　　∗ One CT is required to measure.



Single-phase, three-wire/ Three-phase, three-wire system

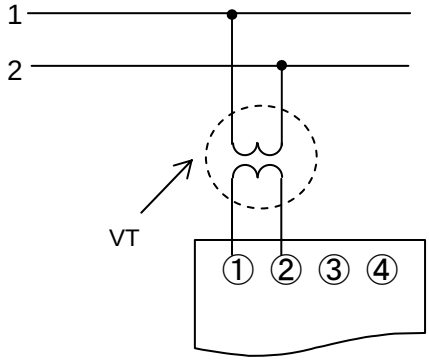
∗ Two CTs are required to measure.



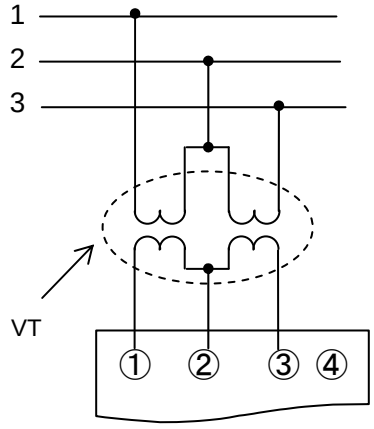
◆When measuring a load with exceed input voltage

Voltage transformer (VT) is needed when you measure a load with over rated input voltage (240V).
Use VT, those secondary rating is 110V.
Grounding the secondary side of VT and CT is not necessary with low-voltage circuit.

Single-phase, two-wire



Single-phase, three-wire / Three-phase, three-wire



*** After wiring, turn on the power supply and turn off and power on again.**

◆How to attach the Current Transformer (CT)

・One CT is needed when measuring 1P2W. Two CTs are needed when measuring 1P3W/3P3W. Using all CTs for one Eco-POWER METER should be the same.

・Check beforehand that the thickness of the electric wire is smaller than the through-hole of the CT.

・When connecting CT, connect the secondary side to the terminal of the main unit first, and after that wire the primary side to a load electric wire.
Incorrect order might cause an electric shock or break CT.

・The CT has polarity. Wire correctly according to the K and L marks.
Wrong direction can't measure correctly.

・When closing CT, check that there is no foreign materials on the divided face. And make sure it is closed securely once the wire is in place; **if not the measurement value will be not accurate.**

・When CT's cable is extended, it is possible to extend up to about 10m with the cable of AWG#22 or more cross section under the environment without noise at all. Please use the thick cable as much as possible. *Please check beforehand with the actual system in case of extending the cable.

・If there is some distortion by harmonic or waveform, it may not measure correctly. Please check with the actual system before adopting it.

・Separate the wiring (strong electric part) of the measured voltage input terminal (operating power supply terminal) from the CT cable. It may not satisfy the accuracy due to noise.

◇To connect CT with secondary side current 5A

How to connect for measuring by combination with CT (secondary side current 5A)

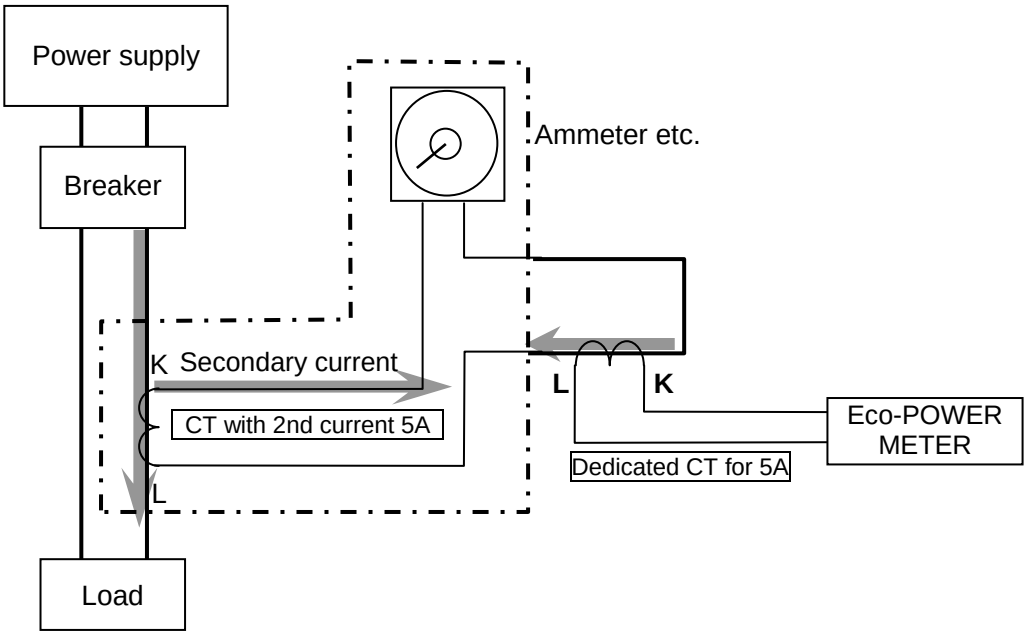
(1) Select 5A at CT type setting mode (CT-T).

(2) Set the primary current of measured CT (secondary side current 5A) at primary side current of CT setting mode (CT-1).
< ex > If the measured CT is 400A/5A, set to"400".

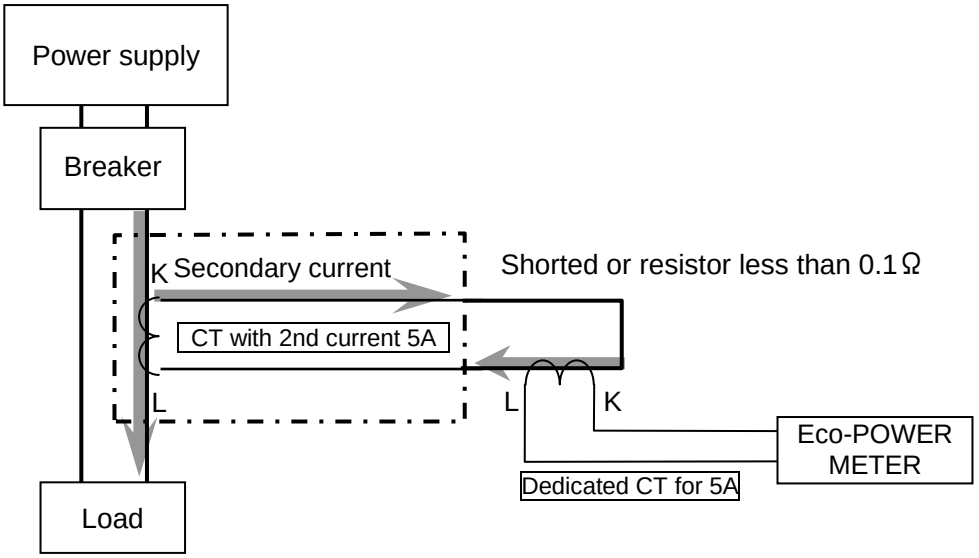
(3) Clamp the dedicated CT for 5A, which is connected to the main unit first, to secondary side of the CT (secondary side current 5A). CT direction (K→L) should be set for the commercial CT direction.

∗ Set the CT (secondary side current 5A) and the dedicated CT for 5A approximately 1m apart. If the two CTs are set too close each other, it may not measure accurately due to magnetic field interference.

(Connection example)
With ammeter etc.

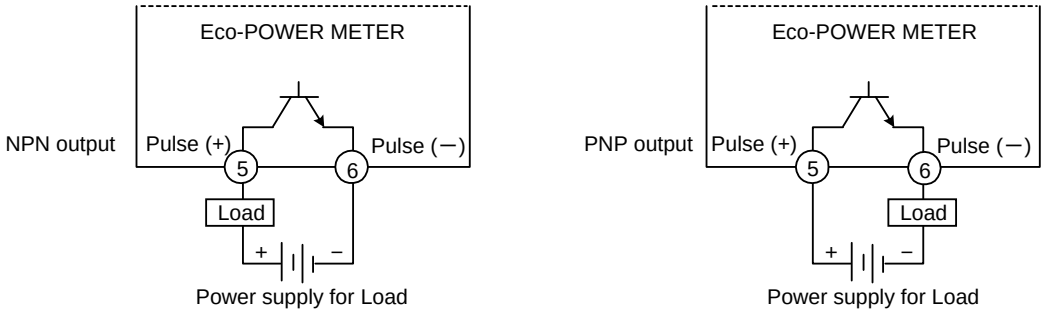


Without ammeter



3.3 For Output connection

・Since the transistor output is insulated from the internal circuit by a photo-coupler, it can be used both as a NPN output and PNP (equal value) output.



・Wire up to 100m for output connection.
If it is long, it may not work correctly due to floating capacitance of wire.

3.4 RS485 Communication

Recommended Cable

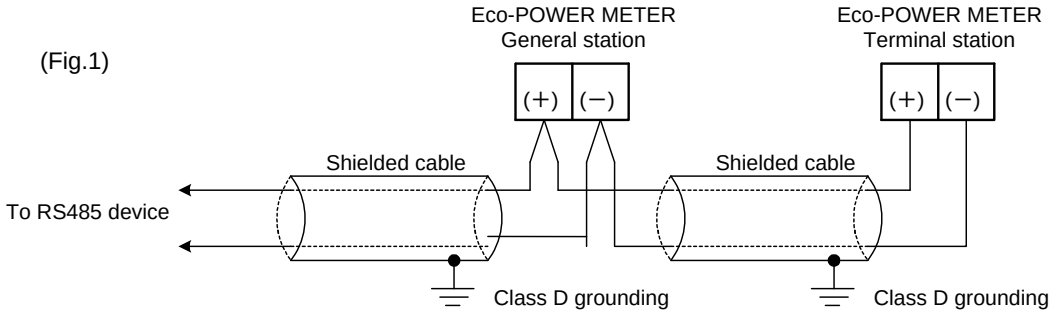
Use the transmission cables shown below for Eco-POWER METER RS485 communication system.

1) Use shielded type twist cables.
2) Use only one type of the transmission cables. Do not mix different types of the cables.
3) Use twist pair cables under a bad noise environment.
4) Be sure to connect with daisy chain the RS485 transmission line between each unit. Connect one end of the shielded wire to an earth ground.
5) Use 2 recommended cables with the same cross section of 0.3 to 0.34mm^2 to connect to the RS485 (+) and RS485 (-) terminals.

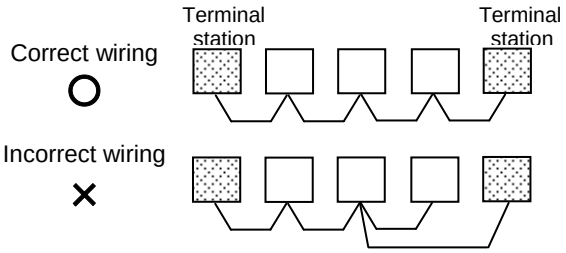
RS485 Wiring and setting of terminal station

1) When using shielded cable for the RS-485 transmission line, ground one end.
Use a class D dedicated earth for grounding. Do not share a ground with other earth lines. (Fig.1)
2) Be sure to connect with daisy chain the RS-485 transmission line between each unit.
Do not use a splitter. (Fig.2)
3) With a terminal station, RS-485 (E) (No.9) and RS-485 (-) (No.8) should be shorted. (Fig.1)
*E terminal is not SG (signal ground) terminal. Do not ground shielded cable.

(Fig.1)



(Fig.2)



3.5 Low Voltage Directive

When using in the application confirming to EN61010-1/IEC61010-1, make sure to satisfy the following conditions.

(1) Pulse output part secure only basic insulation. In order to secure reinforced (double) insulation demanded by EN 61010-1/ IEC61010-1, secure basic insulation or more with load side and reinforced (double) insulation with communication system side.
(2) Provide the voltage input part with an EN60947-1 or EN60947-3 compliant circuit breaker.
The breaker that connects to the voltage input part must arrange at the position easily reached, and display shows it is the breaker of the equipment.
(3) Use a wire with basic insulation or more for a wire cramped (or connected) CT.

【Environmental conditions】

- Overvoltage category Ⅱ, Pollution degree 2
- Indoor use
- An ambient temperature of –10 to 50℃
- An ambient non-condensing humidity of 35 to 85%RH (at 20℃)
- Altitude of 2000m or less

【Mount the product in a place with】

- A minimum of dust, and an absence of corrosive gases
- No flammable, explosive gasses
- Few mechanical vibrations or shocks
- No exposure to direct sunlight
- No large capacity electromagnetic switches or cables through which large current is flowing

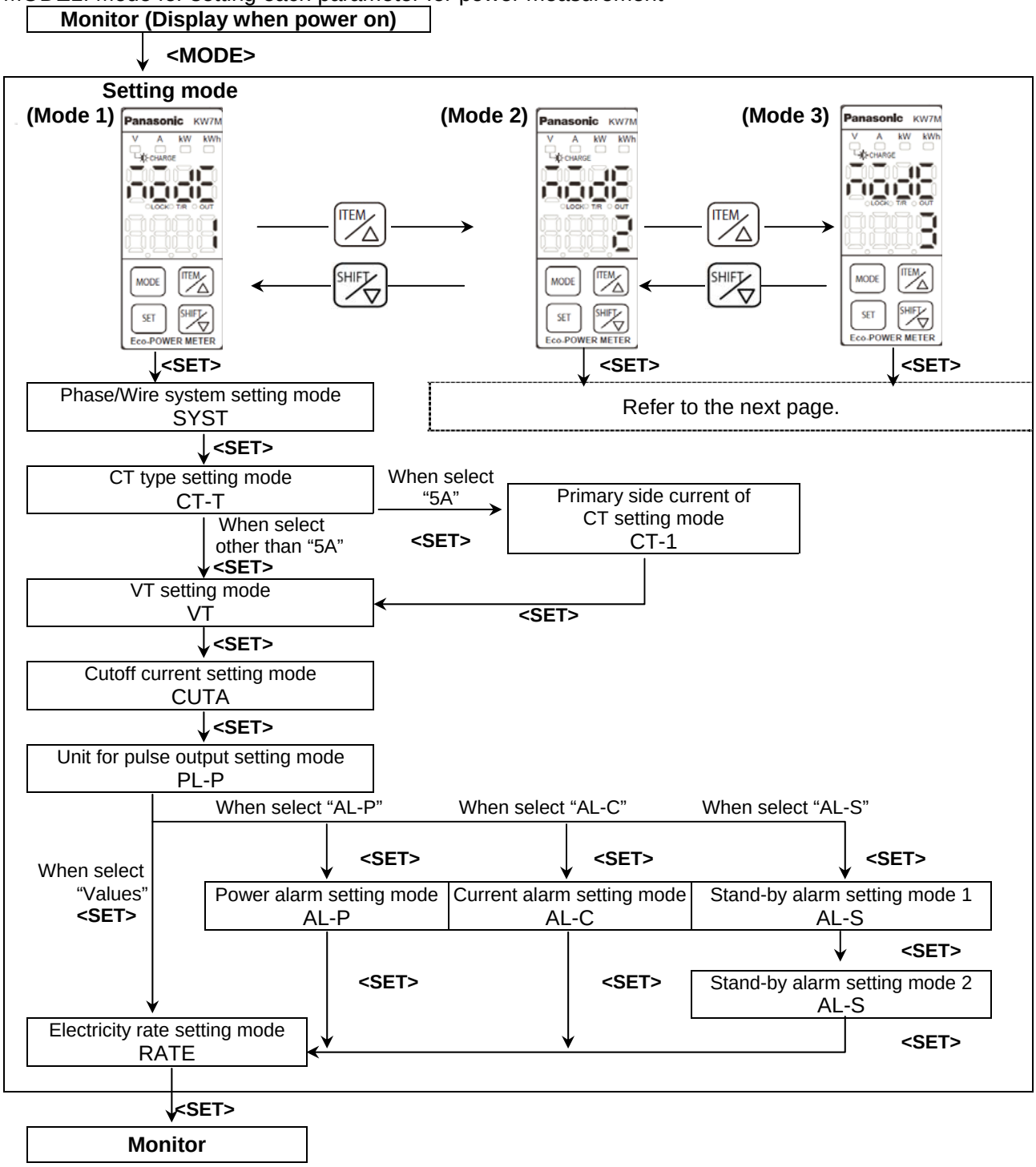
Chapter 4 Settings

4.1 Operation procedure

【Basic setting to measure】

When wiring Eco-POWER METER and CT and setting mode 1 after power on, Eco-POWER Meter can measure the electric power. In order to use the other functions, set mode2 and 3 according to your use.

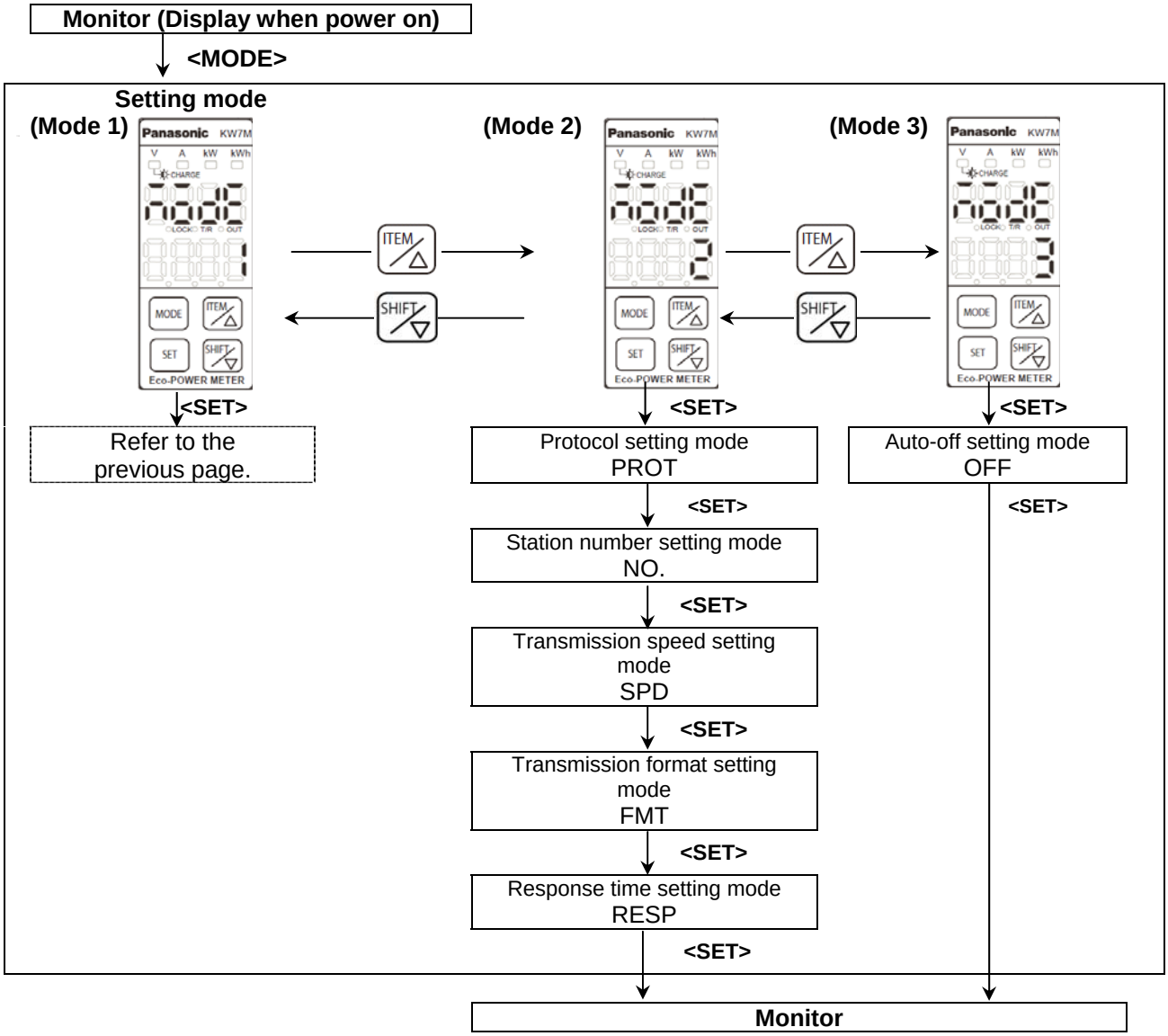
MODE1: Mode for setting each parameter for power measurement



Press <MODE> to return Monitor.

Note) Press <MODE> and <SET> at the same time, the setting will be initialized.

Mode 2: Mode for setting of each parameter for serial communication
Mode 3: Mode for setting of each parameter for optional function



Press <MODE> to return Monitor.
Note) Press <MODE> and <SET> at the same time, the setting will be initialized.

◆Initial value list

Mode 1	
Item	Initial value
Phase/Wire system	1P2W
CT type	50
Primary side current of CT	5
VT	1.00
Cutoff current	1.0
Unit for pulse output	0.001
Power alarm	999999.99
Current alarm	100.0
Stand-by alarm1	100.0
Stand-by alarm 2	0
Electricity rate	10.00

Mode 2	
Item	Initial value
Protocol	MEWTOCOL
Station number	1
Transmission speed	19200
Transmission format	8bit-o
Response time	5

Mode 3	
Item	Initial value
Auto-off	0

4.2 Setting Mode Explanation

■The value with under line is initial setting among each setting value. ☆Set before measurement.

4.2.1 MODE1

(Mode for setting each parameter for power measurement.)

Phase/Wire system setting mode SYST

Mode defines phase and wire system to measure.

・Select from Single-phase 2-wire / Single-phase 3-wire / Three-phase 3-wire.

*When the system is not matched with the measure system, it doesn't measure correctly.

CT type setting mode C T - T

Mode defines input current type of the dedicated CT.

・Select from the type of 5A/50A/100A/250A/400A.

・When the secondary current of CT is 5A, select "5A".

Primary side current of CT setting mode C T - 1

*Only when "5A" is selected on CT type setting mode.

Mode defines primary side current when measuring by combination with existing CT, its secondary current of 5A.

It is possible to use as the second step for combination with existing CT by selecting "5A" in the CT type setting mode. In this case, it is necessary to set the primary side current.

・Primary current of existing CT can be set the range of 1 to 4000 (Initial 5).

・When connecting 5ACT directly and measure with 5A range, set to "5".

ex) If the primary side current of existing CT is 400A(secondary current is 5A), set to "400".

VT ratio setting mode VT

Mode defines voltage-input method to the main unit, input voltage directly or uses a voltage transformer (VT) (over 240V AC).

・It can be set the range of 1.00 to 99.99.

"1.00" should be set when voltage input directly without connecting VT.

"1.01～99.99" should be set when VT is used to input voltage.

ex) If the VT is 440V/110V, set to "4.00".

Cutoff current setting mode C U T A

Mode defines load current that does not measure (Cutoff current).

Use to avoid miss-measurement by wiring or induction noise at no-load.

0.00kW is displayed for instantaneous electric power, 0.0A is displayed for current. Integral electric power is not added.

・It can be set the range of 1.0% to 50.0%.

ex) When set to 10.0, current under 10.0%F.S is not added.

Unit for pulse output setting mode (Power) P L - P

Mode defines unit used for pulse output.

・Select from 0.001/0.01/0.1/1/10/100kWh /AL-P/AL-C/AL-S.

When one of the "0.001/0.01/0.1/1/10/100" [kWh] is set, one pulse is output at reaching the setting value.

When "AL-P" is set, alarm is output at the time when instantaneous electric power is over the setting value.

When "AL-C" is set, alarm is output at the time when current is over the setting value.

When "AL-S" is set, alarm is output at the time when current is under the setting value and it passes the setting time.

Power alarm setting mode AL-P

*Only when "AL-P" is selected on unit for pulse output setting mode.

Mode defines instantaneous electric power used for alarm output.

・It is set the range of 0.00 to 999999.99kW.

Current alarm setting mode AL-C

*Only when “AL-C” is selected on unit for pulse output setting mode.

Mode defines the ratio of current used for alarm output. (Ratio for the rated current)

・It is set the range of 1.0 to 100.0%.

Stand-by alarm setting mode 1 AL-S

*Only when “AL-S” is selected on unit for pulse output setting mode.

Mode defines the ratio of current used for threshold value to judge stand-by power. (Ratio for the rated current)

・It is set the range of 1.0 to 100.0%.

Stand-by alarm setting mode 2 AL-S

*Only when “AL-S” is selected on unit for pulse output setting mode.

Mode defines the time used for threshold value to judge stand-by power.

・It is set the range of 0 to 9999min.

When “0” is set, alarm is always output at the time when judging the stand-by power.

When “1 to 9999” is set, alarm is output at the time when passing the setting time with the stand-by power.

The alarm can be reset by pressing <SET> with the instantaneous electric power display. After reset the alarm, start to monitor the stand-by power again.

Electricity charge setting mode RATE

Mode defines electricity charge ratio used as a standard per 1kWh.

・It can be set the range of 0.0 to 99.99 /1kWh. (Initial 10.00)

Mode1 Setting flow chart

Monitor

↓ **<MODE>**

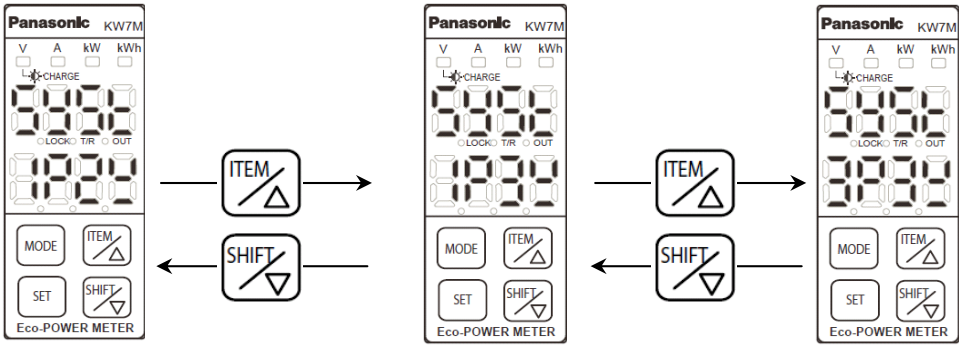
MODE1 display

↓ **<SET>**

Phase/Wire system setting mode

Press <ITEM/△>,<SHIFT/▽> to change

Single-phase 2-wire ⇔ Single-phase 3-wire ⇔ Three-phase 3-wire.

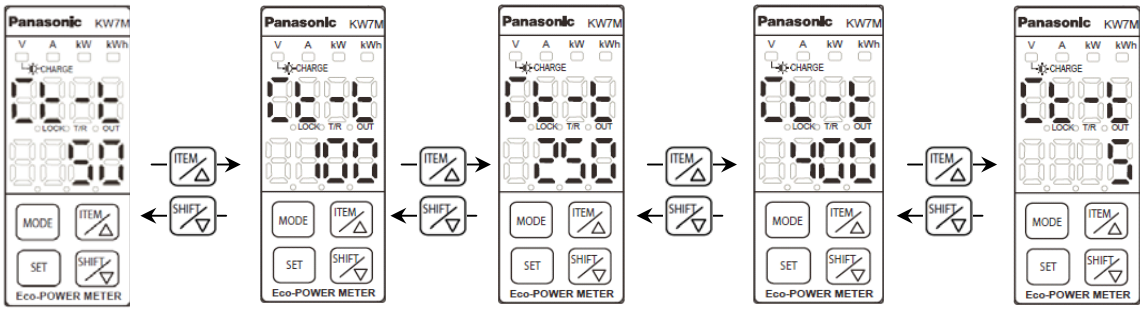


1P2W (Single-phase 2-wire) 1P3W (Single-phase 3-wire) 3P3W (Three-phase 3-wire)

↓ **<SET>**

CT type setting mode

Press <ITEM/△>,<SHIFT/▽> to change 50 ⇔ 100 ⇔ 250 ⇔ 400 ⇔ 5.



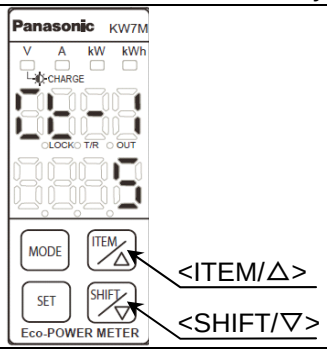
50 100 250 400 5

Primary side current of CT setting mode

*It is only when “5A” is selected on CT type setting mode.

Set primary side current of CT using <ITEM/△>,<SHIFT/▽>.
If primary current of measured CT is 100A
(secondary is 5A), set to 100.
If it is 5A, set to 5.

(1 to 4000, Initial 5)

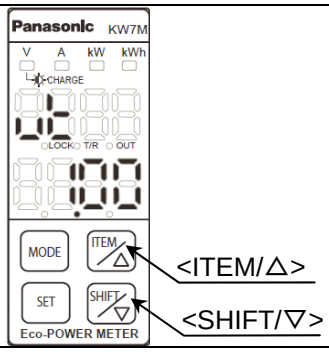


↓ **<SET>**

VT ratio setting mode

Set VT ratio using <ITEM/△>,<SHIFT/▽>.
If the VT is 440/110, set to “4.00”.

(1.00 to 99.99)

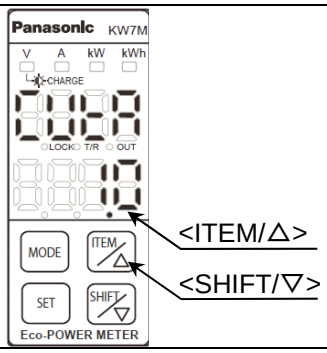


↓ **<SET>**

Cutoff current setting mode

Set cutoff current using <ITEM/△>, <SHIFT/▽>.
If you don’t measure the current under 10.0%F.S,
set to “10.0”.

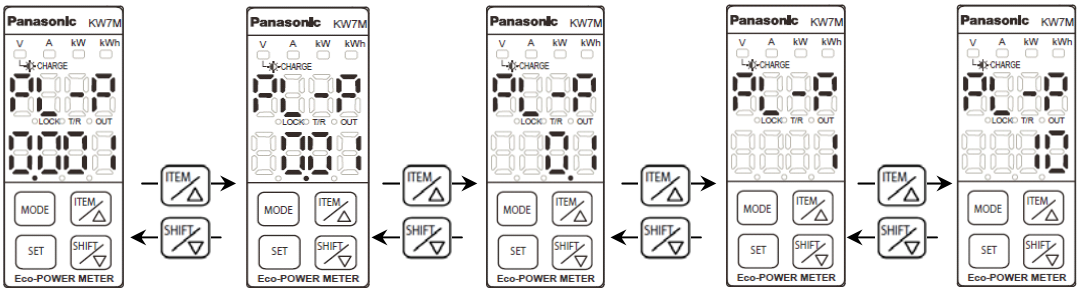
(1.0 to 50.0)



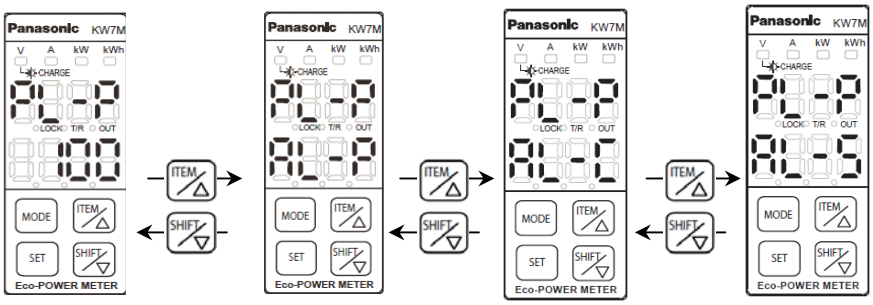
↓ **<SET>**

Unit for pulse output setting mode

Press <ITEM/△>, <SHIFT/▽> to change 0.001→0.01→0.1→1→10→100→
AL-P(Power alarm)→AL-C(Current alarm)→AL-S(Stand-by alarm).



0.001 0.01 0.1 1 10

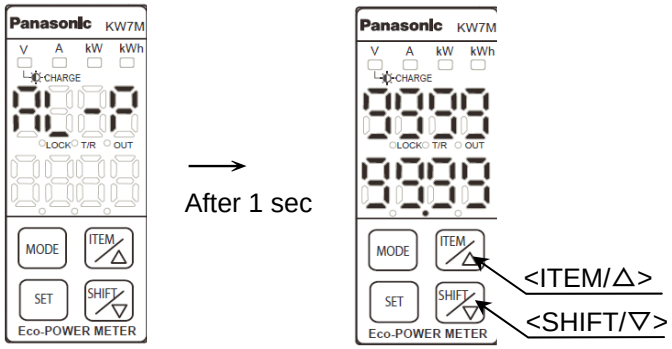


100 AL-P AL-C AL-S

<SET>

Power alarm setting mode *It is only when “AL-P” is selected on unit for pulse output setting mode.

Display changes to set an alarm value after “AL-P” is displayed at the upper line for 1 sec.
Set electric power for alarm using <ITEM/△>,<SHIFT/▽>. (0.00 to 999999.99)

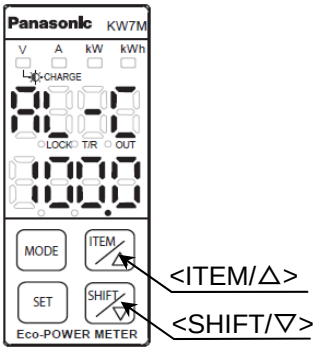


<SET>

Current alarm setting mode *It is only when “AL-P” is selected on unit for pulse output setting mode.

Set current ratio (for the rated current) for alarm using <ITEM/△>,<SHIFT/▽>.

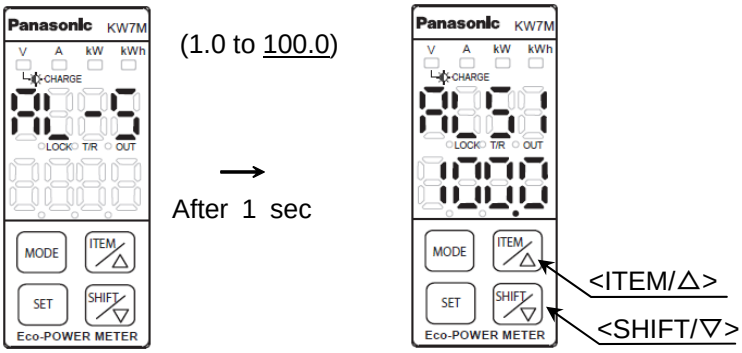
(1.0 to 100.0)



<SET>

Stand-by alarm setting mode 1 *It is only when “AL-S” is selected on unit for pulse output setting mode.

Display changes to set an alarm value after “AL-S” is displayed at the upper line for 1 sec.
Set a ratio (for the rated current) of current used for threshold value to judge stand-by power using <ITEM/△>,<SHIFT/▽>.



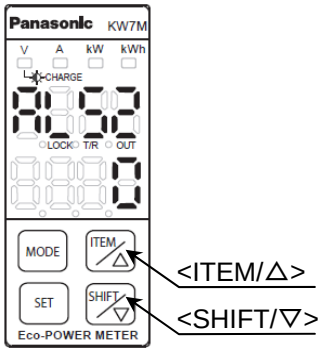
↓ <SET>

Stand-by alarm setting mode 2 *It is only when “AL-S” is selected on unit for pulse output setting mode.

Set a time used for threshold value to judge stand-by power using <ITEM/△>,<SHIFT/▽>.

(0 to 9999 min.)

“0”: Alarm is always output at the time when judging the stand-by power.
“1 to 9999”: Alarm is output at the time when passing the setting time with the stand-by power.
The alarm can be reset by pressing <SET>
with the instantaneous electric power display.
After reset the alarm, start to monitor the stand-by power again.

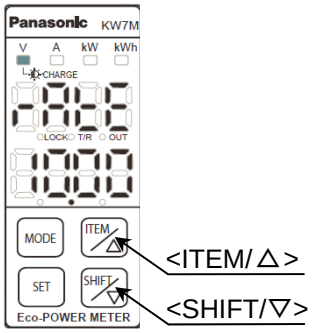


↓ <SET>

Electricity charge setting mode

Set the rate per 1kWh using <ITEM/△>、<SHIFT/▽>.

(0.00 to 99.99 Initial 10.00)



↓ <SET>

Monitor

4.2.2 MODE2

(Mode for setting of each parameter for serial communication (RS485))

Protocol setting mode PROT

Mode defines communication protocol of main unit via serial communication (RS485).

・Select from MEWTOCOL / MODBUS(RTU).

Station number setting mode NO.

Mode defines an individual station no. for each unit when two or more units communicate via serial communication (RS-485).

・It can be set the range of 1 to 99.

Transmission speed (Baud rate) setting mode SPD

Mode defines serial communication (RS-485) transmission speed. Define the transmission speed according to the master's (PLC etc.).

・Select from 38400/19200/9600/4800/2400[bps].

Transmission format setting mode FMT

Mode defines serial communication (RS-485) transmission format (Data length, Parity). Define the transmission format according to the master's (PLC etc).

・Select from 8bit-o/7bit-n/7bit-E/7bit-o/8bit-n/8bit-E.

"n (none)" means parity is not available.

"E (Even)" means parity is even number.

"o (odd)" means parity is odd number.

*With MODBUS (RTU) protocol, it works only with 8bit.

Response time setting mode RESP

Mode defines serial communication (RS-485) response time of main unit.

When command is received, it sends response after setting response time passes.

・It can be set the range of 1 to 99 ms (initial 5).

MODE2 Setting flow chart

Monitor

↓ **<MODE>**

MODE 1 display

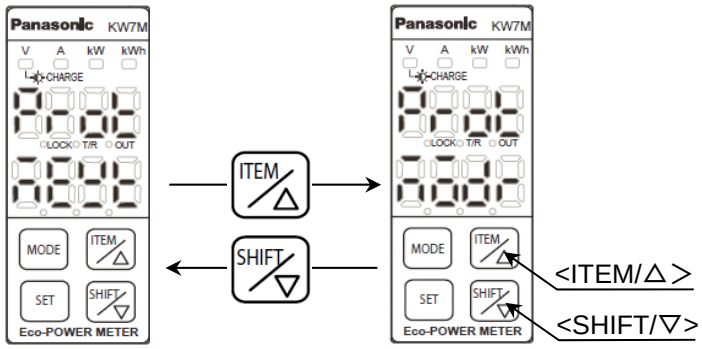
↓ **<ITEM/△>**

MODE 2 display

↓ **<SET>**

Protocol setting mode

Press <ITEM/△>, <SHIFT/▽> to change MEWTOCOL ⇔ MODBUS(RTU).



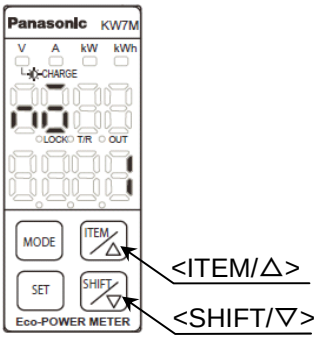
MEWTOCOL MODBUS(RTU)

↓ **<SET>**

Station number setting mode

Set the station number using <ITEM/△>,<SHIFT/▽>.

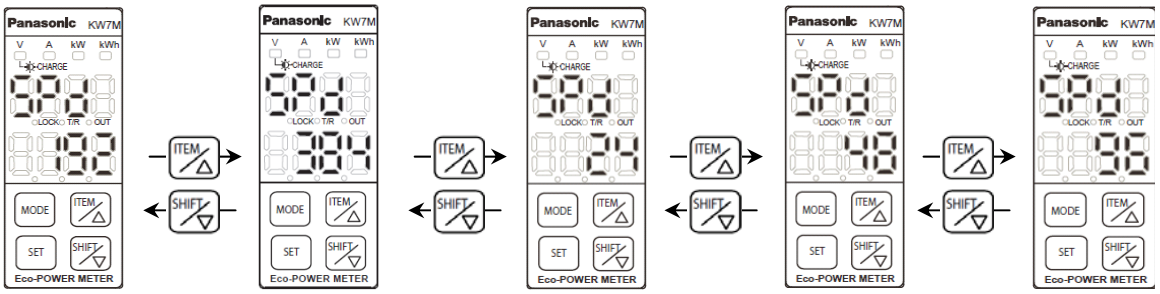
(1 to 99)



↓ **<SET>**

Transmission speed setting mode

Press <ITEM/△>,<SHIFT/▽> to change 19200 ⇔ 38400 ⇔ 2400 ⇔ 4800 ⇔ 9600.



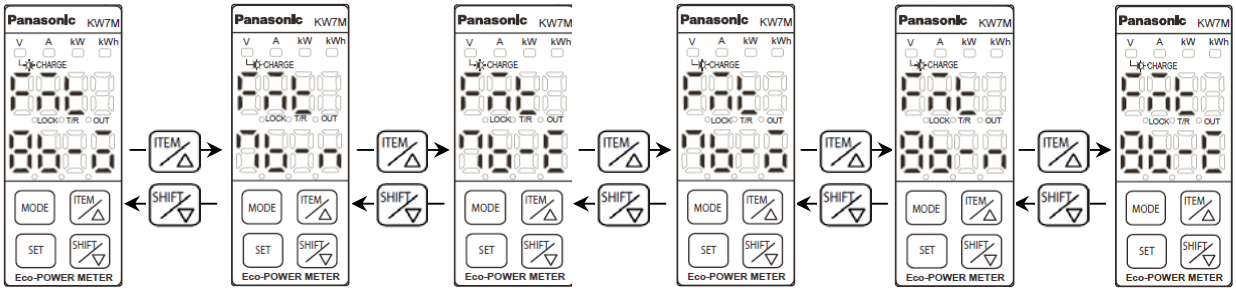
19200bps 38400bps 2400bps 4800bps 9600bps

↓ **<SET>**

Transmission format setting mode

Press <ITEM/△>,<SHIFT/▽> to change 8bit-o ⇔ 7bit-n ⇔ 7bit-E ⇔ 7it-o ⇔ 8bit-n ⇔ 8bit-E.

n: not available E: even number o: odd number



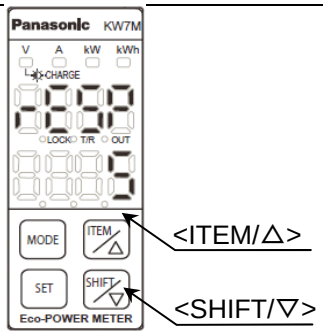
8bit-o 7bit-n 7bit-E 7it-o 8bit-n 8bit-E

⬇ **<SET>**

Response time setting mode

Set the response time using <ITEM/△>,<SHIFT/▽>.

(1 to 99 ms initial 5)



⬇ **<SET>**

Monitor

4.2.3 MODE3

(Mode for setting of each parameter for optional function)

Auto-off setting mode OFF

Display LED turns off automatically when there is no key operation for a long time.

・Off time can be set the range of 0 to 99min.
"0" is set if you want to turn always light on.
"1 to 99" is set if you want to turn light off at setting time.
・After turns off the backlight, any key operation makes it turns on.
・After turns off the backlight, one decimal point at the right end is blinking.

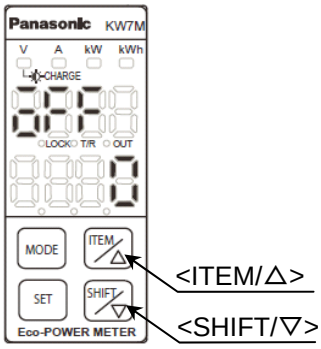
MODE3 Setting flow chart

Monitor
↓ **<MODE>**
MODE 1 display
↓ **<ITEM/△>**
MODE 2 display
↓ **<ITEM/△>**
MODE3 display
↓ **<SET>**

Auto-off setting mode

Set auto-off time by minute using <ITEM/△>,<SHIFT/▽>.

(0 to 99)



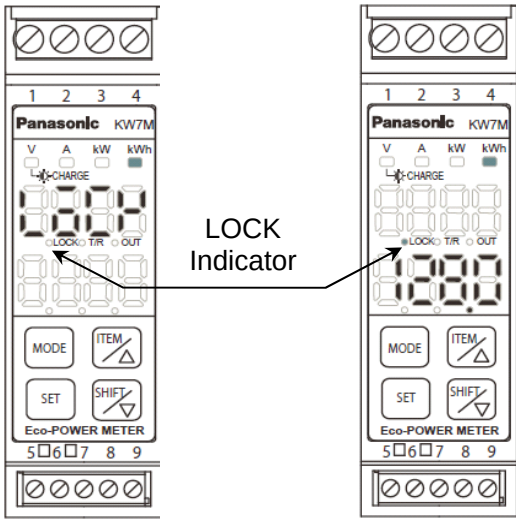
"0" is set to turn always light on.
"1~99" is set to turn light off at setting time (minute).
While light off, press any key to light on.

↓ **< SET >**
Monitor

Chapter 5 Various Functions

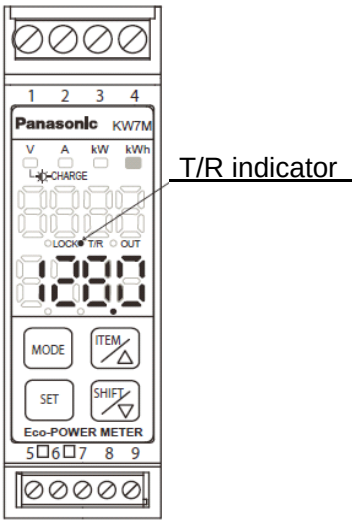
5.1 LOCK mode

It is the mode makes all keys unable. Use when you want to fix one of the measurement displays (For all displays). In this mode, you can not input by any keys.
When you press <SET> continuously for about 3sec., the "LOCK" is displayed and the indicator lights. After about 3 sec., "LOCK" is disappeared and the display shift to previous display. All keys become locked (pressing them will have no effect).
Press <SET> continuously for about 3sec. again to release Lock mode. The "LOCK" indicator goes off and the lock mode is released (unlocked)



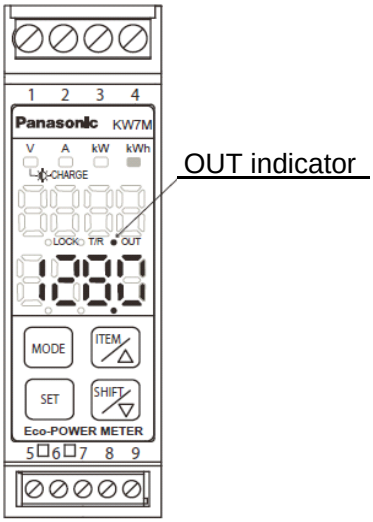
5.2 Display while communication

T/R indicator is blinking while Eco-POWER METER is under communication.



5.3 Display when pulse output

OUT indicator is lighting when pulse output.



5.3.1 Output depends on integral electric power

Set the unit for pulse output (0.001/0.01/0.1/1/10/100kWh) and pulse output (transistor output) turns on every time when integral electric power reaches the unit. (Pulse width: about 100ms)

5.3.2 Instantaneous electric power alarm

When it exceeds the setting instantaneous electric power, pulse output (transistor output) turns on in order to notice. When it falls below, the output turns off.

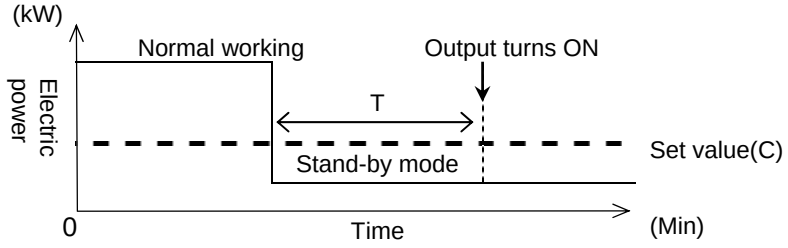
5.3.3 Current alarm

When it exceeds the setting current ratio, pulse output (transistor output) turns on in order to notice. When it falls below, the output turns off.

5.3.4 Stand-by power alarm

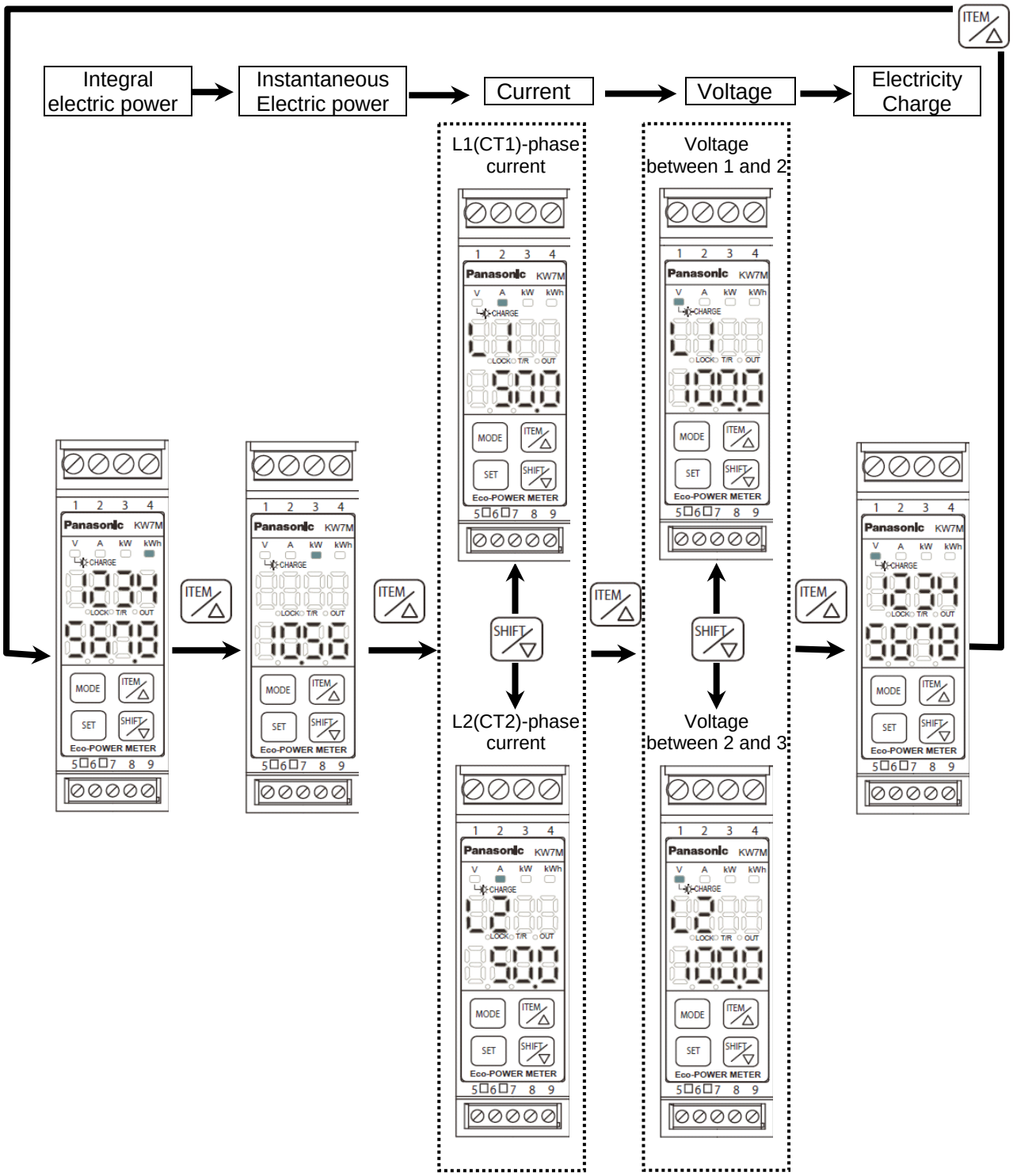
When it detects stand-by power (current) of the measured load, pulse output (transistor output) turns on in order to notice.
Set current (C) and stand-by time (T) to judge stand-by power.
When the measured load is satisfied the setting conditions, pulse output (transistor output) turns on in order to notice.
When it exceeds the setting value, it turns off and reset it.
You can reset the alarm by pressing <SET> with the instantaneous electric power display.

(Working flow chart)



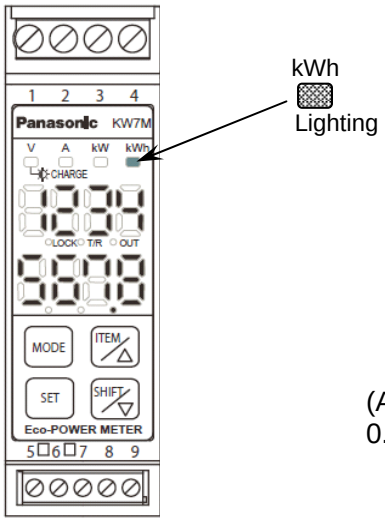
Chapter 6 Display of each Value

6.1 Outline for the Working of Monitor Display



6.2 Integral electric power

・It displays the integral electric power(kWh).



・Integral electric power is measured and displayed from 0.00kWh to 9999999.9kWh.

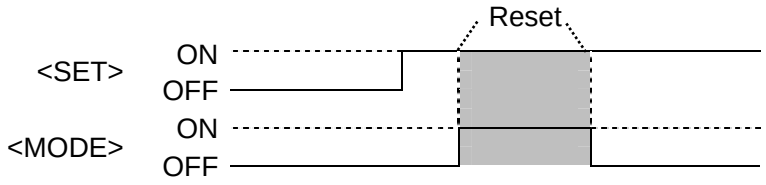
・The decimal point is changed automatically.

kWh → 0.00 → kWh 999999.99 → kWh 1000000.0 → kWh 9999999.9 → (back to 0.00)

(After reaching the full scale (9999999.9kWh), the value reverts to 0.00kWh but continues to measure.)

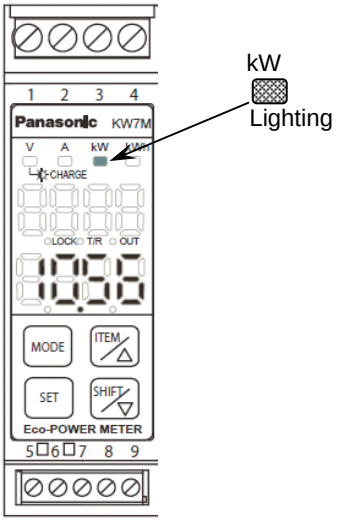
How to reset the integral electric power

・Press <MODE>key while pressing <SET>key makes integral electric power clear.



6.3 Instantaneous electric power

・It displays the Instantaneous electric power(kW).



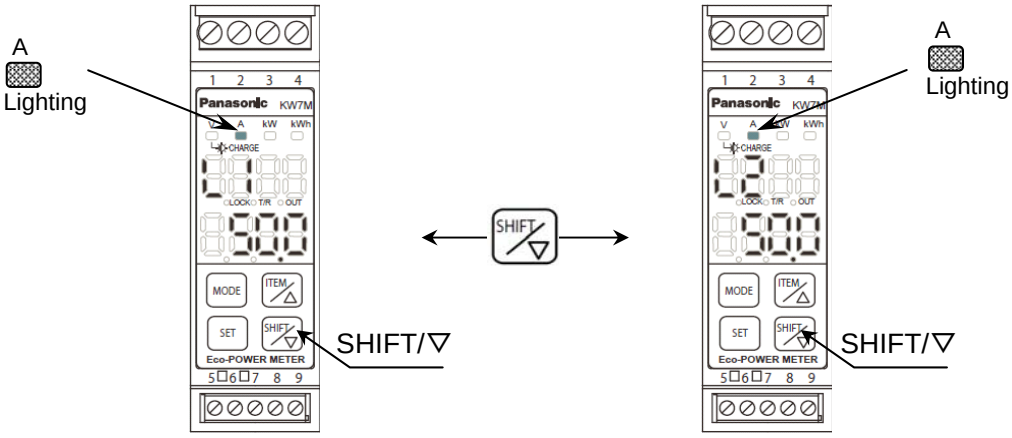
6.4 Current

・It displays the current value of the load.

・Press <SHIFT/▽> to change L1(CT1)-phase current to L2(CT2)-phase current.

*Before start measuring, select phase and wire system according to the measured load.
When Single-phase 3-wire or Three-phase 3-wire is selected, it doesn't measure Single-phase 2-wire system correctly. Select phase and wire system according to the measured system. (Refer to the explanation of setting mode.)

L1(CT1)-phase current (A) → L2(CT2)-phase current (A)



・When input current exceeds 150%F.S. at each range, 「 」 will be displayed in the lower line.

・Current measurement parts
Eco-POWER METER measures the current as below.

System \ Display	L1(CT1)A	L2(CT2)A
Single-phase two-wire	1(L1)-phase current	-
Single-phase three-wire	1(R)-phase current	3(T)-phase current
Three-phase three-wire	1(R)-phase current	3(T)-phase current

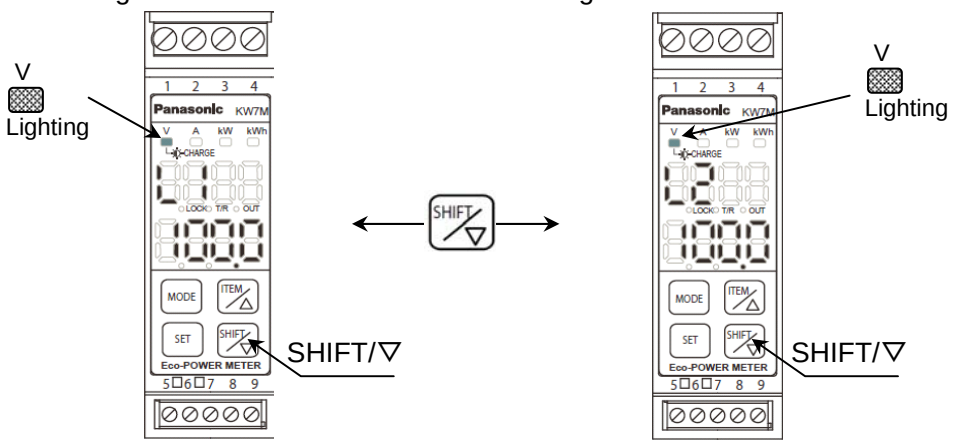
6.5 Voltage

・It displays the voltage value of the load.

・Press <SHIFT/▽>key to change voltage between 1 and 2 to 2 and 3.

※Before start measuring, select phase and wire system according to the measured load.
When Single-phase 3-wire or Three-phase 3-wire is selected, it doesn't measure Single-phase 2-wire system correctly. Select phase and wire system according to the measured system. (Refer to the explanation of setting mode.)

Voltage between 1 and 2 → Voltage between 2 and 3



・When input voltage exceeds 150%F.S. at each range, 「 」 will be displayed in the lower line.

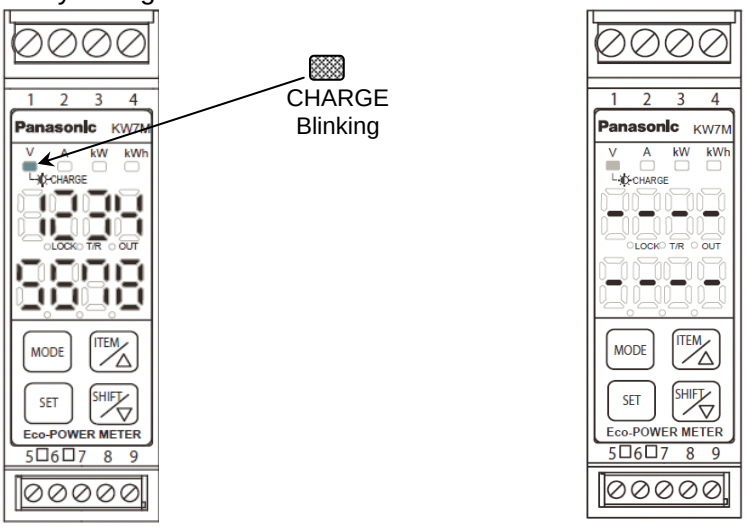
・Voltage measurement parts
Eco-POWER METER measures the voltage as below.

System \ Display	L1V	L2V
Single-phase two-wire	Voltage between 1 and 2 (R-phase)	–
Single-phase three-wire	Voltage between 1 and 2 (R-phase)	Voltage between 2 and 3 (T-phase)
Three-phase three-wire	Voltage between 1 and 2 (Between R and S line)	Voltage between 2 and 3 (Between S and T line)

6.6 Electricity Charge

・It displays the standard electricity charge for the integral electric power.

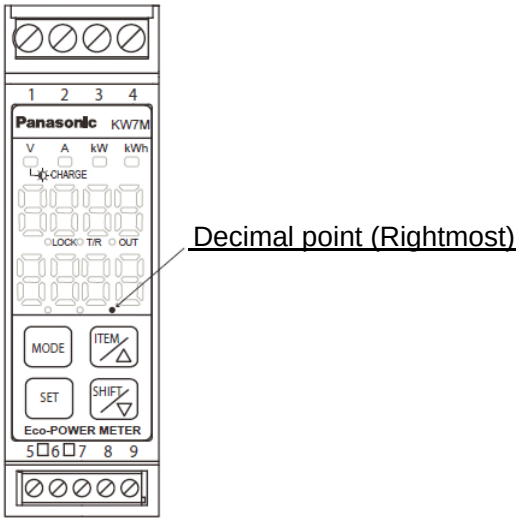
Electricity Charge



*When the value exceeds '99999999',
" - - - - - - - - " will be displayed.

6.7 Display when LED turns off

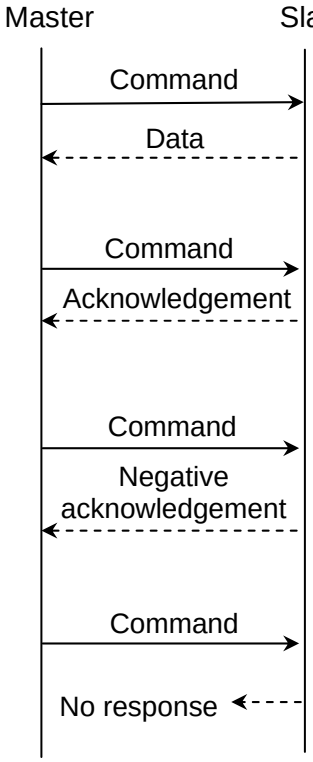
Last decimal point is blinking when LED turns off automatically.
(Refer to the Setting Mode Explanation for setting in detail.)



Chapter 7 MEWTOCOL Communications

7.1 Communication Procedures

Communication starts with command transmission from the host computer (hereafter Master) and ends with the response of Eco-POWER METER (hereafter Slave).



• Response with data
When master sends reading command, slave responds with the corresponding set value or current status.

• Acknowledgement
When master sends setting command, slave responds by sending the acknowledgement.

• Negative acknowledgement
When master sends a non-existent command or value out of the setting range, the slave returns negative acknowledgement.

• No response
Slave will not respond to master in the following cases.
- Global address “FF” (MEWTOCOL) is set.
- Broadcast address “00H” (Modbus protocol) is set.
- Communication error (framing error, parity error)
- CRC-16 discrepancy (Modbus RTU mode)

7.2 Communication timing

◆The minimum access time from the master is 1 sec. (Minimum time for update the data)
Eco-POWER METER may not response due to noise and so on, be sure to check that it receives the response from Eco-POWER METER.

◆In order to improve the communication quality, we recommend to send the transmission again.

Communication timing of RS-485

◇Eco-POWER METER (Slave) side

When Eco-POWER METER (Slave) starts transmission to RS-485 communication line, it is arranged so as to provide an idle status transmission period of about 1 to 99ms (setting available) before sending the response to ensure the synchronization on the receiving side. After sending the response, master can disconnect the transmitter from the communication line within transmission period 20ms.

◇Master side (Cautions of setting a program)

At communication, keep the following conditions.

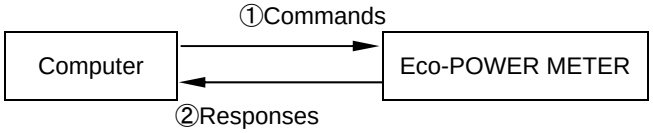
1) Set the program so that the master can disconnect the transmitter from the communication line within the transmission period of about 3ms after sending the command in preparation for reception of the response from Eco-POWER METER (Slave).
2) To avoid collision of transmissions between the master and Eco-POWER METER (Slave), send a next command after checking that the master received the response.

7.3 MEWTOCOL Communication

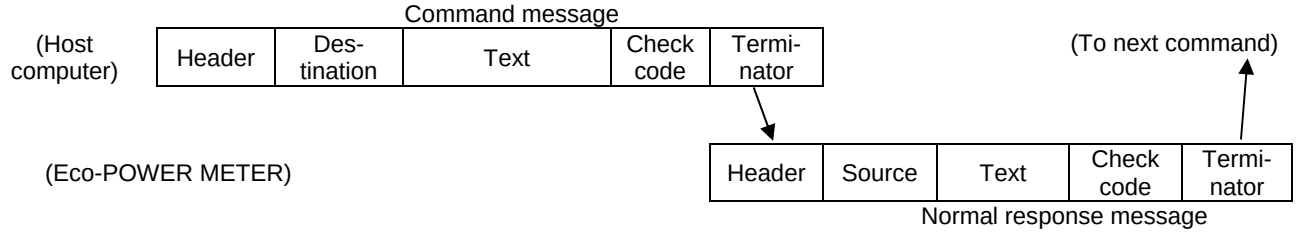
7.3.1 Overview of MEWTOCOL-COM (RS-485)

◆Command and response functions

The computer sends commands (instructions) to Eco-POWER METER, and receives responses in return. This enables the computer and Eco-POWER METER to converse with each other, so that various kinds of information can be obtained and provided.



◆Command and response formats



◇Control codes

Name	Character	ASCII code	Explanation
Header	%	25H	Indicates the beginning of a message.
Command	#	23H	Indicates that the data comprises a command message.
Normal response	$	24H	Indicates that the data comprises a normal response message.
Error response	!	21H	Indicates that the data comprises a response message when an error occurs.
Terminator	CR	0DH	Indicates the end of a message.

◇Destination and source AD (H), (L)

Two-digit decimal 01 to 99 (ASCII codes)

Command messages contain a station number for Eco-POWER METER that receives the message.

When FF (ASCII code table) is used, however, the transmission is a global transmission (sent to all stations at once).

Note) When a global transmission is sent, no response to the command message is returned.

◇Block check code Bcc (H), (L)

Two- digit hexadecimal 00 to FF (ASCII codes)

These are codes (horizontal parity) that are used to detect errors in the transmitted data.

If "**" is entered instead of "Bcc", however, messages can be transmitted without the Bcc. In this case, the Bcc is included with the response

◇Error code Err (H), (L)

Two- digit hexadecimal 00 to FF (ASCII codes)

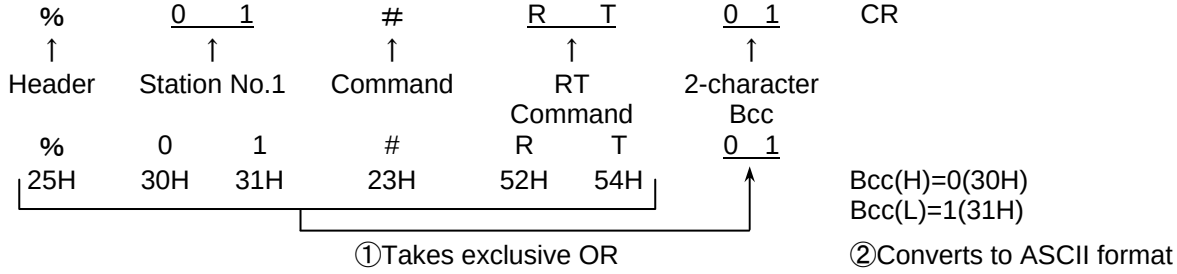
These indicate the content if error occurs.

◆Bcc（Block Check Code）

-The Bcc is a code that carries out an error check using horizontal parity, to improve the reliability of the data being sent.

-The Bcc uses an exclusive OR from the header (%) to the final character of the text, and converts the 8- bit data into a 2-character ASCII code.

Example)



7.3.2 Data Register List

Data register	Name	Unit	Kind of data	Range	R/W
DT00050	Rate	0.01	Sign-less 16bit	0 to 9999	R/W
DT00100 DT00101	Integral electric power	0.01kWh	Sign-less 32bit	0 to 999999999	R/W
DT00107	L1 (CT1)-phase current	0.1A	Sign-less 16bit	0 to 60000	R
DT00109	L2 (CT2)-phase current	0.1A	Sign-less 16bit	0 to 60000	R
DT00060	CT type	Rated A (rms)	Sign-less 16bit	5,50,100,250,400	R/W
DT00061 DT00062	Unit for Pulse output	—	Sign-less 32bit	1(0.001),10(0.01),100(0.1), 1000(1),10000(10),100000(100) 999(Instantaneous electrical energy: Values of DT00064 and 00065 are applied) 777 (Ratio for current alarm: Value of DT00069) 333 (Ratio and time for Stand-by alarm: Value of DT00077,00078)	R/W
DT00063	Primary side current value when CT 5A	A	Sign-less 16bit	1 to 4000	R/W
DT00064 DT00065	Alarm value (Instantaneous electric power)	0.01kW	Sign-less 32bit	0 to 99999999	R/W
DT00066	VT ratio	0.01	Sign-less 16bit	100 to 9999	R/W
DT00068	Cutoff current	0.1%	Sign-less 16bit	10 to 500	R/W
DT00069	Ratio for current alarm	0.1%	Unsigned 16bit	10 to 1000	R/W
DT00077	Ratio for stand-by current	0.1%	Unsigned 16bit	10 to 1000	R/W
DT00078	Time for stand-by alarm	1min.	Unsigned 16bit	0 to 9999	R/W
DT00170 DT00171	Voltage between 1 and 2	0.1V	Sign-less 32bit	0 to 99999	R
DT00172 DT00173	Voltage between 2 and 3	0.1V	Sign-less 32bit	0 to 99999	R
DT00176 DT00177	Instantaneous electric power	0.01kW	Sign-less 32bit	0 to 99999999	R

Note1) R: Read W: Write

2) Data register except specified is 0.

3) If each setting value is wrote by communication, it memories to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM's life short. Avoid to usage like this.

4) Write a data within the range when you write it.

7.3.3 Error Codes

◆Basic procedure errors

Error code	Error name	Explanation
40H	Bcc error	・A Bcc error occurred in the command data.
41H	Format error	・A command message was sent that does not fit the transmission format.
42H	No support error	・A command was sent that is not supported.
43H	Procedure error	・Delimiter with multiple frames was sent. ・The response shall be multiple frames.

◆Application error

Error code	Error name	Explanation
60H	Parameter error	・The data code is not “D”.
61H	Data error	・Word No. was specified without decimal.（0000F etc.） ・The starting word No. is bigger than the ending word No. ・Writing data has a code that is not hexadecimal.
62H	Registration error	・Too many registrations have been entered (more than 17). ・“MD” command was sent when some registration has been exist. ・“MG” command was sent when registration has not been entered.

◆Self-diagnostic error

Error code	Error name	Explanation
45H	Operation error	・At “WD” command, writing data is exceeded the range of data register.

7.3.4 Command

Eco-POWER METER has 5 kinds of commands.

Command name	Code	Explanation
Read data area	RD	Reads the contents of data area.
Write data to data area	WD	Writes data to a data area.
Resister or Reset data monitored	MD	Resisters the data to be monitored.
Monitoring start	MG	Monitors a registered data.
Read status	RT	Reads the specifications of Eco-POWER METER and error code if an error occurs.

◆[RD]: Read data area (Reads the contents of data area.)

◇Command

%	Destination ×10¹ ×10⁰	#	R	D	D	Starting word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	Ending word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	Bcc ×16¹ ×16⁰	CR

◇Normal response (Read successful)

%	Source ×10¹ ×10⁰	$	R	D	First register contents 4 characters ×16¹ ×16⁰ ×16³ ×16²	Last register contents 4 characters ×16¹ ×16⁰ ×16³ ×16²	Bcc ×16¹ ×16⁰	CR

(lower word) (higher word) (lower word) (higher word)

◇Error response

%	Source ×10¹ ×10⁰	!	Error code ×16¹ ×16⁰	Bcc ×16¹ ×16⁰	CR

(Common to each command)

◆[WD]: Write data area (Writes date to a data area.)

◇Command

%	Destination ×10¹ ×10⁰	#	W	D	D	Starting word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	Ending word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	First writing data 4 characters ×16¹ ×16⁰ ×16³ ×16²	⇒

(lower word) (higher word)

◇Normal response (Write successful)

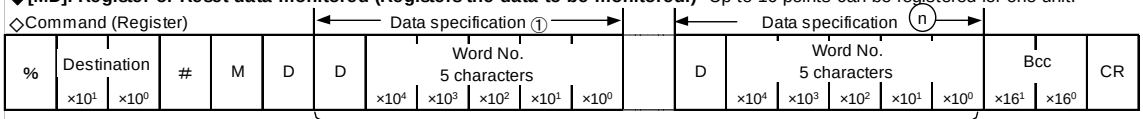
%	Source ×10¹ ×10⁰	$	W	D	Bcc ×16¹ ×16⁰	CR

⇒	Last writing data 4 characters ×16¹ ×16⁰ ×16³ ×16²	Bcc ×16¹ ×16⁰	CR

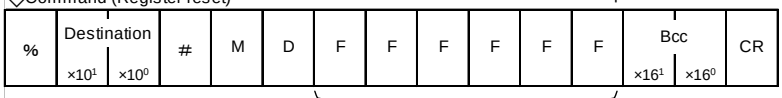
(lower word) (higher word)

◆[MD]: Register or Reset data monitored (Registers the data to be monitored.) *Up to 16 points can be registered for one unit.

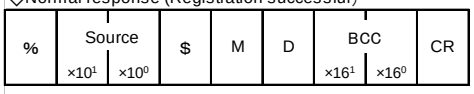
◇Command (Register)


Data specification ①
Data specification n
% Destination ×10¹ ×10⁰ # M D D Word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ D Word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ Bcc ×16¹ ×16⁰ CR
16 points max.

◇Command (Register reset)

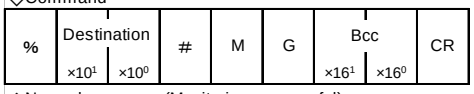


◇Normal response (Registration successful)

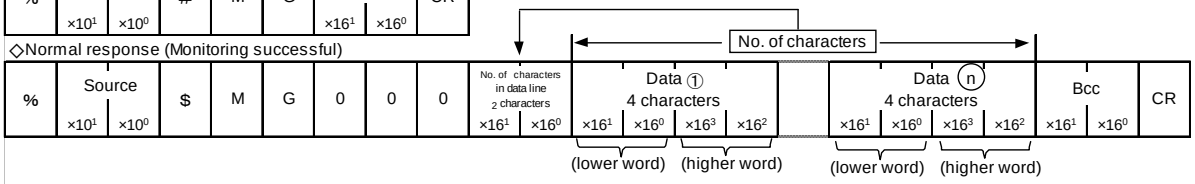


◆[MG]: Monitoring start (Monitors a registered data.)

◇Command



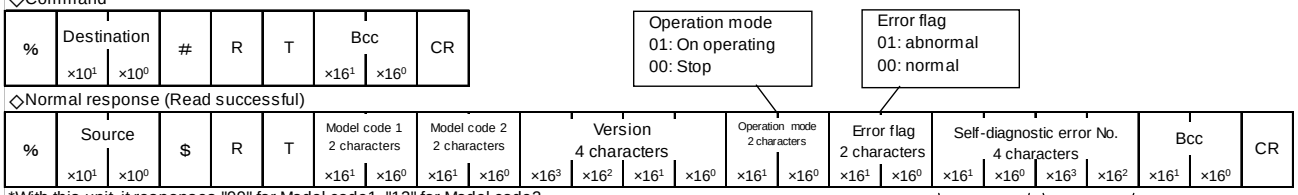
◇Normal response (Monitoring successful)


No. of characters
% Source ×10¹ ×10⁰ $ M G 0 0 0 No. of characters in data line 2 characters ×16¹ ×16⁰ Data ① 4 characters ×16¹ ×16⁰ ×16³ ×16² Data n 4 characters ×16¹ ×16⁰ ×16³ ×16² Bcc ×16¹ ×16⁰ CR
(lower word) (higher word)
(lower word) (higher word)

◆[RT]: Read the status of Eco-POWER METER (Reads the specifications of Eco-POWER METER and error codes if an error occurs.)

◇Command

◇Normal response (Read successful)


Operation mode
01: On operating
00: Stop
Error flag
01: abnormal
00: normal
% Source ×10¹ ×10⁰ $ R T Model code 1 2 characters ×16¹ ×16⁰ Model code 2 2 characters ×16¹ ×16⁰ Version 4 characters ×16³ ×16² ×16¹ ×16⁰ Operation mode 2 characters ×16¹ ×16⁰ Error flag 2 characters ×16¹ ×16⁰ Self-diagnostic error No. 4 characters ×16¹ ×16⁰ ×16³ ×16² Bcc ×16¹ ×16⁰ CR
(lower word) (higher word)

*With this unit, it responses "99" for Model code1, "12" for Model code2.

7.4 MODBUS (RTU) Communication

7.4.1 Overview of MODBUS (RTU)

◆8-bit binary data in command is transmitted as it is.

Data format	Start bit	: 1 bit
	Data bit	: 8 bits ＊7bits is not available.
	Parity	: No parity, Even parity, Odd parity Selectable
	Stop bit	: 1 bit (Fixed)
	Error detection	: CRC-16 (Cyclic Redundancy Check)
	Data interval	: 3.5 character transmission time or more

◆Message configuration

RTU mode is configured to start after idle time processing of more than 3.5 character transmissions and end after idle time processing of more than 3.5 character transmissions.

3.5 idle characters	Slave address	Function code	Data	Error check CRC-16	3.5 idle characters
	8-bit	8-bit	＊＊bits	16-bit	

Master judges the transmission complete after no command for 4-characters idle time and process the command.

*Transmission speed and judgement time to complete transmission

Transmission speed (bps)	Judgement time to complete (ms)
38400	about 1.00
19200	about 2.00
9600	about 4.00
4800	about 8.00
2400	about 16.00

◇Slave address:

Slave address is an individual instrument number on the slave side and is set within the range 1 to 99 (01H to 63H). Master identifies slaves by the slave address of the requested message.

Slave informs master which slave is responding to master by placing its own address in the response message. Slave address 0 (00H, broadcast address) can identify all slaves connected. However slaves do not respond.

◇Function code: Function code is command code for the slave to undertake the following action types.

Function code	Contents
03(03H)	DT read
06(06H)	DT 1-word write
16(10H)	DT several data write

Function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) has occurred when slave returns response message to master.

When acknowledgement is returned, slave simply returns original function code. When negative acknowledgement is returned, MSB of original function code is set as 1 for response.

For example, when the master sends request message setting 00H to function code by mistake, slave returns 80H by setting MSB to 1, because the former is an illegal function.

For negative acknowledgement, the exception codes below are set to data of response message and returned to master in order to inform it of what kind of error has occurred.

Exception code	Contents
1(01H)	Illegal Function (Non-existent function)
3(03H)	Illegal data value (Value out of the devise numbers)

note1) Even if it commands to write (06H, 10H) to non-existent data address, slave response with acknowledgement. However, it doesn't write.

note2) Even if it commands to write the value out of the setting range, slave response with acknowledgement. However, it doesn't write.

note3) The maximum number of reading slaves is 26 (57 bytes), the maximum number of writing slaves is 23 (55 bytes).

◇Data: Data depends on the function code.
A request message from the master side is composed of data item, number of data and setting data.
A response message from the slave side is composed of number of bytes, data and exception code in negative acknowledgement.

◇Error check: 16-bit data to detect communication errors. Refer to the next.

◇Acknowledgement response
When command is to write 1 point, same massage of command is responded.
When command is to write several points, part of command message (6 bytes) is responded.

◆Error check
After calculating CRC-16 (Cyclic Redundancy Check) from slave address to the end of data, the calculated 16-bit data is appended to the end of message in sequence from low order to high order.
<How to calculate CRC>
In CRC system, the information is divided by the polynomial series. The remainder is added to the end of the information and transmitted. The generation of polynomial series is as follows.
(Generation of polynomial series: $X^{16} + X^{15} + X^{2} + 1$)

1) Initialize the CRC-16 data (assumed as X) (FFFFH).
2) Calculate exclusive OR (XOR) with the 1st data and X. This is assumed as X.
3) Shift X one bit to the right. This is assumed as X.
4) When a carry is generated as a result of the shift, XOR is calculated by X of 3) and the fixed value (A001H). This is assumed as X. If a carry is not generated, go to step 5).
5) Repeat steps 3) and 4) until shifting 8 times.
6) XOR is calculated with the next data and X. This is assumed as X.
7) Repeat steps 3) to 5).
8) Repeat steps 3) to 5) up to the last data.
9) Set X as CRC-16 to the end of message in sequence from low order to high order.

◆Message example
<1> Reading electricity rate (0032H) of address 1
・Command

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (0032H)	Number of data (0001H)	Error check CRC-16 (25C5H)	3.5 idle characters
	1	1	2	2	2	←character number

・Response message from slave in normal status (When Rate=1000(10.00) [03E8H])

3.5 idle characters	Slave address (01H)	Function code (03H)	Number of response byte (02H)	Number of data (03E8H)	Error check CRC-16 (B8FAH)	3.5 idle characters
	1	1	1	2	2	←character number

<2> Setting electricity rate (0032H) of address 1 (When rate is set to 20.00(2000) [07D0H])
・Command

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (0032H)	Number of data (07D0H)	Error check CRC-16 (2BA9H)	3.5 idle characters
	1	1	2	2	2	←character number

・Response message from slave in normal status

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (0032H)	Number of data (07D0H)	Error check CRC-16 (2BA9H)	3.5 idle characters
	1	1	2	2	2	←character number

<3> Reset integral electric power (0064H, 0065H: 2-word) of address 1

(When setting to 0 [0000, 0000H])

・Command

3.5 idle characters	Slave address (01H)	Function code (10H)	Data item (0064H)	Number of data item to write (0002H)	Number of data (04H)	⇒
	1	1	2	2	1	←character number

⇒	Data 1 (0000H)	Data 2 (0000H)	Error check CRC-16 (F474H)	3.5 idle characters
	2	2	2	←character number

・Response message from slave in normal status

3.5 idle characters	Slave address (01H)	Function code (10H)	Data item (0064H)	Number of data item to write (0002H)	Error check CRC-16 (0017H)	3.5 idle characters
	1	1	2	2	2	←character number

・A response message from the slave in exception (error) status

(When number of data has been mistaken.)

Function code MSB is set to 1 for the response message in exception (error) status (90H).
The exception code 03H (Value out of the devise numbers) is returned as contents of error.

<Mistaken message example (Command)>

3.5 idle characters	Slave address (01H)	Function code (10H)	Number of data item to write (0002H)	Number of data ***(06H)***	⇒
				↑ **Mistake**	

⇒	Data 1 (0000H)	Data 2 (0000H)	Error check CRC-16 (8F8E)	3.5 idle characters

<Response message from slave to mistaken command
(Response message in exception (error) status)>

3.5 idle characters	Slave address (01H)	Function code (90H)	Exception code (03H)	Error check CRC-16 (0C01H)	3.5 idle characters

7.4.2 Data Register List

Data item (MEWTOCOL)	Name	Unit	Kind of date	Range: Hexadecimal (Range: Decimal)	MODBUS Function code
0032H (DT00050)	Rate	0.01	Unsigned 16bit	0H to 270FH (0 to 9999)	03H/ 06H/10H
0064H (DT00100)	Integral electric power	0.01kWh	Unsigned 32bit	0H to 3B9AC9FFH (0 to 999999999)	03H/ 06H/10H
0065H (DT00101)					
006BH (DT00107)	L1 (CT1)-phase current	0.1A	Unsigned 16bit	0H to EA60H (0 to 60000)	03H
006DH (DT00109)	L2 (CT2)-phase current	0.1A	Unsigned 16bit	0H to EA60H (0 to 60000)	03H
003CH (DT00060)	CT type	Rated A (rms)	Unsigned 16bit	5H(5),32H(50),64H(100), FAH(250),190H(400)	03H/ 06H/10H
003DH<LSB> (DT00061)	Unit for Pulse output	—	Unsigned 32bit	1H(1)<0.001>, AH(10)<0.01>, 64H(100)<0.1>, 3E8H(1000)<1>, 2710H(10000)<10>, 186A0H(100000)<100>, 3E7H(999) <Instantaneous electrical energy: Values of DT00064 and 00065 are applied)> 309H(777) < Ratio for current alarm: Value of 0045 H> 14DH(333) < Ratio and time for Stand-by alarm: Value of 004DH,004EH>	03H/ 06H/10H
003EH<MSB> (DT00062)					
003FH (DT00063)	Primary side current value when CT 5A	1A	Unsigned 16bit	1H to FA0H (1 to 4000)	03H/ 06H/10H
0040H<LSB> (DT00064)	Alarm value (Instantaneous electric power)	0.01kW	Unsigned 32bit	0H to 5F5E0FFH (0 to 99999999)	03H/ 06H/10H
0041H<MSB> (DT00065)					
0042H (DT00066)	VT ratio	0.01	Unsigned 16bit	64H to 270FH (100 to 9999)	03H/ 06H/10H
0044H (DT00068)	Cutoff current	0.1%	Unsigned 16bit	AH to 1F4H (10 to 500)	03H/ 06H/10H
0045H (DT00069)	Ratio for current alarm	0.1%	Unsigned 16bit	1H to 3E8H (1 to 1000)	03H/ 06H/10H
004DH (DT00077)	Ratio for stand-by current	0.1%	Unsigned 16bit	AH to 3E8H (10 to 1000)	03H/ 06H/10H
004EH (DT00078)	Time for stand-by alarm	1min	Unsigned 16bit	1H to 270FH (1 to 9999)	03H/ 06H/10H
00AAH<LSB> (DT00170)	Voltage between 1 and 2	0.1V	Unsigned 32bit	0H to 1869FH (0 to 99999)	03H
00ABH<MSB> (DT00171)					
00ACH<LSB> (DT00172)	Voltage between 2 and 3	0.1V	Unsigned 32bit	0H to 1869FH (0to 99999)	03H
00ADH<MSB> (DT00173)					
00B0H<LSB> (DT00176)	Instantaneous electric power	0.01kW	Unsigned 32bit	0H to 5F5E0FFH (000 to 99999999)	03H
00B1H<MSB> (DT00177)					

<LSB>: Least Significant Byte
<MSB>: Most Significant Byte
note 1) 03H: Read 06H/10H: Write
note 2) Data register except specified is “0”.
note 3) If each setting value is wrote by communication, it memories to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM’s life short. Avoid to usage like this.
note 4) Write a data within the range when you write it.

Chapter 8 Specifications

8.1 Main unit

Rated operating voltage	100 / 200V AC	
Rated frequency	50/60Hz common	
Rated power consumption	6VA (240V AC at 25℃)	
Allowable operating voltage range	85-132/170-264V AC (85%～110% of rated operating voltage)	
Allowable momentary power-off time	10ms	
Ambient temperature	-10 to +50℃ (-25 to +70℃ at storage)	
Ambient humidity	30 to 85%RH (at 20℃) non-condensing	
Breakdown voltage(initial)	Between the isolated circuits: 2000V for 1min note) Cut-off current: 10mA	・Insulated circuit （Between ①－②, ②－③, ①－③） ①Power terminal (1(R),2(N,S),3(T)), CT input terminal (CT1(+),CT2(+),CT1,2(-)) ②RS-485 terminal(+,-,E) ③Pulse output terminal(+,-) ・Outer edge (enclosure) －all terminals
Insulation resistance(initial)	Between the isolated circuits: 100MΩor more (measured with 500V DC)	
Vibration resistance	10 to 55Hz (1cycle/min) single amplitude : 0.375mm(1h on 3 axes)	
Shock resistance	Min. 294m/s2 (5 times on 3 axes)	
Display method	8-digit, 7-segment LED	
Power failure memory method	EEP-ROM (more than 100,000 overwrite)	
Weight	approx.100g	

8.2 Input Specifications

Phase and wire system		Single-phase two-wire system Single-phase three-wire system (common) Three-phase three-wire system
Input voltage	Rating	Single-phase two-wire : 100-120/200-240V AC（common） Single-phase three-wire : 100-120V AC Three-phase three-wire : 100-240V AC
	Allowance	85 to 110% of rated input voltage
	Allowable measurement voltage	Single-phase two-wire : 85-132/170-264V AC（common） Single-phase three-wire : 85-132V AC Three-phase three-wire : 85-264V AC
	VT ratio	1.00 to 99.99 (Set with setting mode) ***Voltage transformer (VT) is required when you measure a load with voltage over 240VAC (Allowable measurement voltage).** ***Secondary voltage rating of VT is 110V.**
Input current	Primary side rating	<Using the dedicated CT> ・5A/50A/100A/250A/400A (Select with setting mode) <Using a commercial CT with the secondary side current 5A> ・1 to 4000A (Set with setting mode) ***Use CT with secondary side current of 5A when measure 400A or more.**
Cut-off current		1.0 to 50.0%F.S

Accuracy (without error in CT and VT)	Basic accuracy	Instantaneous electric power / Integral electric power / Electricity charge
		Within ± (2.0 % F.S. + 1 digit) (at 20 °C, rated input, rated frequency, power factor 1) In case of 5 A CT mode, within ± (2.5 % F.S. + 1 digit) ***Accuracy coverage:5 to 100% of rated current**
		Current
		Within ± (1.0 % F.S. + 1 digit) In case of 5 A CT mode, within ± (2.5 % F.S. + 1 digit) (at 20 °C rated input, rated frequency, power factor 1) ***Accuracy coverage: 5 to 100 % of rated current**
		Voltage
		Within ± (1.0 % F.S. + 1 digit) (at 20 °C rated input, rated frequency, power factor 1)
	Temperature characteristics	Within ± (1.0 % F.S.+ 1 digit) In case of 5 A CT mode, within ± (1.5 % F.S. + 1 digit) (Range of -10 to 50 °C 14 to 122 °F, rated input, power factor 1)
	Frequency characteristics	Within ± (1.0 % F.S. + 1 digit) In case of 5 A CT mode, within ± (1.5 % F.S. + 1 digit) (Frequency change ± 5 % based on rated frequency, rated input, power factor 1)

8.3 Pulse output (Transistor output) Specifications

Number of output point	1 point
Insulation method	Optical coupler
Output type	Open collector
Output capacity	100mA 30V DC
Pulse width	approx. 100ms
ON state voltage drop	1.5V or less
OFF state leakage current	100 μA or less
Pulse output unit	0.001/0.01/0.1/1/10/100kWh/ Power alarm(AL-P)/Current alarm(AL-C) /Stand-by alarm (AL-S) (Selectable with setting mode)

* We recommend the setting of minimum unit for pulse output for measurement shown as below.
Output pulse: 4 pulses or less per 1sec.

How to calculate

(Unit for pulse output: PL-P)＞(Max. measurement power [kW]）／(3600[s]×4 [pulse/s])

Note (1) Improper unit setting may cause miss counting.
(2) If the OFF time is too short, there is a possibility of counting errors.

8.4 Communication Specifications

Interface		Conforming to RS-485
Protocol		MEWTOCOL/MODBUS(RTU) (selectable with setting mode)
Isolation status		Isolated with the internal circuit
Number of connected units		99 (max.) ※2 ※3
Transmission distance		1200m (max.) ※1
Transmission speed		38400/19200/9600/4800/2400bps (selectable with setting mode)
Transmission Format	Data length	8bit/7bit (selectable with setting mode) ※4
	Parity	Not available / Odd number / Even number (selectable with setting mode)
	Stop bit	1bit（fixed）
Communication method		Half-duplex
Synchronous system		Synchronous communication method
Transmission line		Twisted-pair cable with shield or VCTF
Communication mode		1 : N communication
Ending resistance		approx. 120Ω (built-in) (Terminal (E) and terminal (－) is shorted when ending.)

*1 Please check with the actual devices when some commercial devices with RS485 interface are connected. The number of connected devices, transmission distance, and transmission speed may be different according to using transmission line.

*2 For RS485 converter on the computer side, we recommend SI-35 and SI-35USB (from LINE EYE Co., Ltd.).

*3 When using SI-35, SI-35USB or PLC from our company (which can be connected up to 99 units), up to 99 Eco-POWER METER can be connected. In case using this system with the other devices, up to 31 Eco-POWER METER can be connected.

*4 With MODBUS (RTU) protocol, it works only with 8bit.

8.5 Self-diagnostic function

If an error occurs, the following indication will be given.

Indicator	Meaning	Output status	To recover
ERR0	CPU error	OFF	Turn the power off and then on again.
ERR1	Memory error*		EEP-ROM life ended. Replace the unit.

*Includes the possibility that the EEP-ROM's life has expired.

8.6 Power Failure Memory

Eco-POWER METER memories integral electric power and working status to internal EEP-ROM until when power supply is off. (power failure guarantee)

And every time to change each setting, each setting value is memorized to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM's life short. Avoid to usage like this.

*Especially be careful if you set by communication.

8.7 Applicable standard

Safety standard	EN61010-1		
EMC	EMI EN61326-1	Radiation interference field strength Noise terminal voltage	CISPR11 class A CISPR11 class A
	EMS EN61326-1	Static discharge immunity RF electromagnetic field immunity EFT/B immunity Surge immunity Conductivity noise immunity Power frequency magnetic field immunity Voltage dip / Instantaneous stop / Voltage fluctuation immunity	EN61000-4-2 EN61000-4-3 EN61000-4-4 EN61000-4-5 EN61000-4-6 EN61000-4-8 EN61000-4-11

8.8 Dedicated Current Transformer Specifications

●Clamp-on type

Model No		AKW4801C	AKW4802C	AKW4803C	AKW4804C
Primary side rated current		5A / 50A	100A	250A	400A
Secondary side rated Current		1.67mA / 16.7mA	33.3mA	125mA	200mA
Transform ratio		3000:1	3000:1	2000:1	2000:1
Ratio error		±2.0% F.S.			
Hole Dia (mm)		ϕ10	ϕ16	ϕ24	ϕ36
Breakdown voltage (initial)		AC1000V/1min (Between through hole and output lead wire)		AC2000V/1min (Between through hole and output lead wire)	
Insulation resistance (initial)		Min. 100MΩ (at DC500V) (Between through hole and output lead wire)			
Vibration resistance	Functional	10 to 55Hz (1 cycle/ minute) single amplitude of 0.15mm (10 min. on X,Y and Z axes)			
	Destructive	10 to 55Hz (1 cycle/ minute) single amplitude of 0.375mm (1 hrs. on X,Y and Z axes)			
Shock resistance	Functional	Min. 98m/s^2 (4 times on X,Y and Z axes)			
	Destructive	Min. 294m/ s^2 (5 times on X,Y and Z axes)			
Output protection level		±7.5V with clamp element		±3.0V with clamp element	
Permissible clamping frequency		Approx. 100 times			
Ambient temperature		-10 to +50℃ (without frost and non-condensing)			
Storage temperature		-20 to +60℃ (without frost and non-condensing)			
Ambient humidity		30 to 85%RH (at 20℃) non-condensing			
Weight (with relay cable)		Approx. 60g	Approx. 90g	Approx. 200g	Approx. 295g

●Through type

Model No		AKW4506C	AKW4507C
Primary side rated current		50A / 100A	250A / 400A
Secondary side rated Current		16.7mA / 33.3mA	125mA / 200mA
Transform ratio		3000:1	2000:1
Ratio error		±1.0%F.S.	
Hole Dia (mm)		ϕ17	ϕ36
Breakdown voltage (initial)		AC1000V/1min （Between through hole and output lead wire）	AC2000V/1min （Between through hole and output lead wire）
Insulation resistance (initial)		Min. 100MΩ (at DC500V) (Between through hole and output lead wire)	
Vibration resistance	Functional	10 to 55Hz (1 cycle/ minute) single amplitude of 0.15mm (10 min. on X,Y and Z axes)	
	Destructive	10 to 55Hz (1 cycle/ minute) single amplitude of 0.375mm (1 hrs. on X,Y and Z axes)	
Shock resistance	Functional	Min. 98m/s^2 (4 times on X,Y and Z axes)	
	Destructive	Min. 294m/ s^2 (5 times on X,Y and Z axes)	
Output protection level		±7.5V with clamp element	±3.0V with clamp element
Ambient temperature		-10 to +50℃ (without frost and non-condensing)	
Storage temperature		-20 to +60℃ (without frost and non-condensing)	
Ambient humidity		35 to 80%RH (at 20℃ non-condensing)	
Weight (with relay cable)		Approx. 70g	Approx. 200g

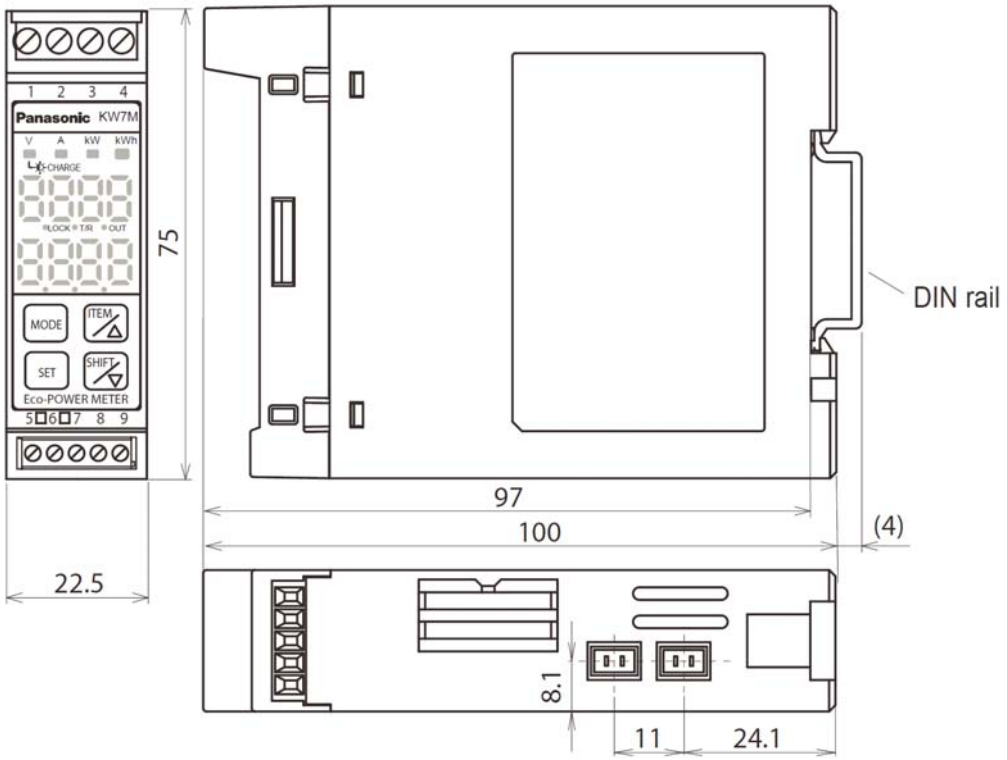
Note) Dedicated current transformers (CT) are dedicated for low voltage under 440V. They can not be used for high voltage circuit. In case measuring high voltage circuit, make a 2-step construction by combination of a commercial CT of secondary side current 5A for high voltage and the dedicated CT for 5A.

Chapter 9 Mounting

9.1 Dimensions

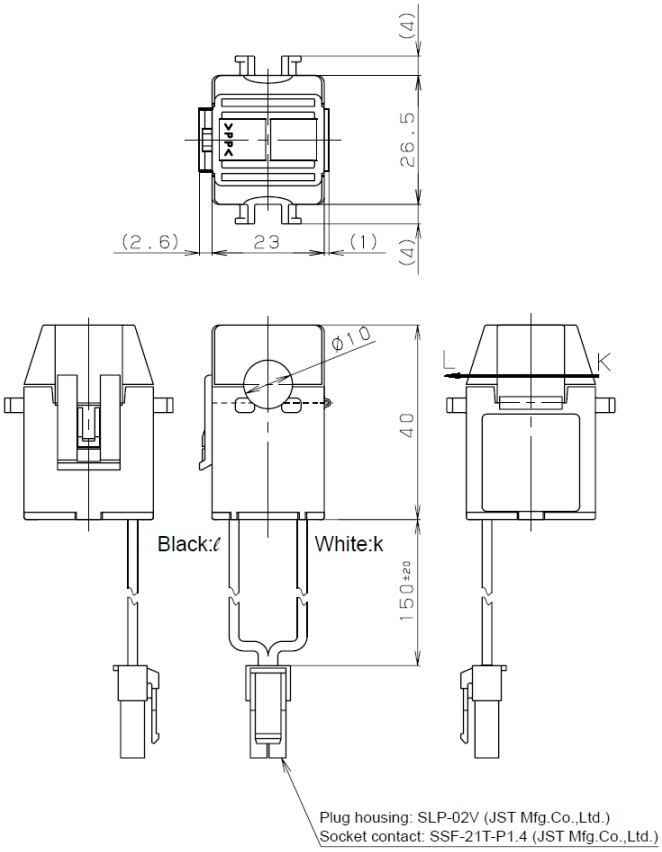
(Unit: mm)
(Clearance: ±1.0)

9.1.1 Main unit

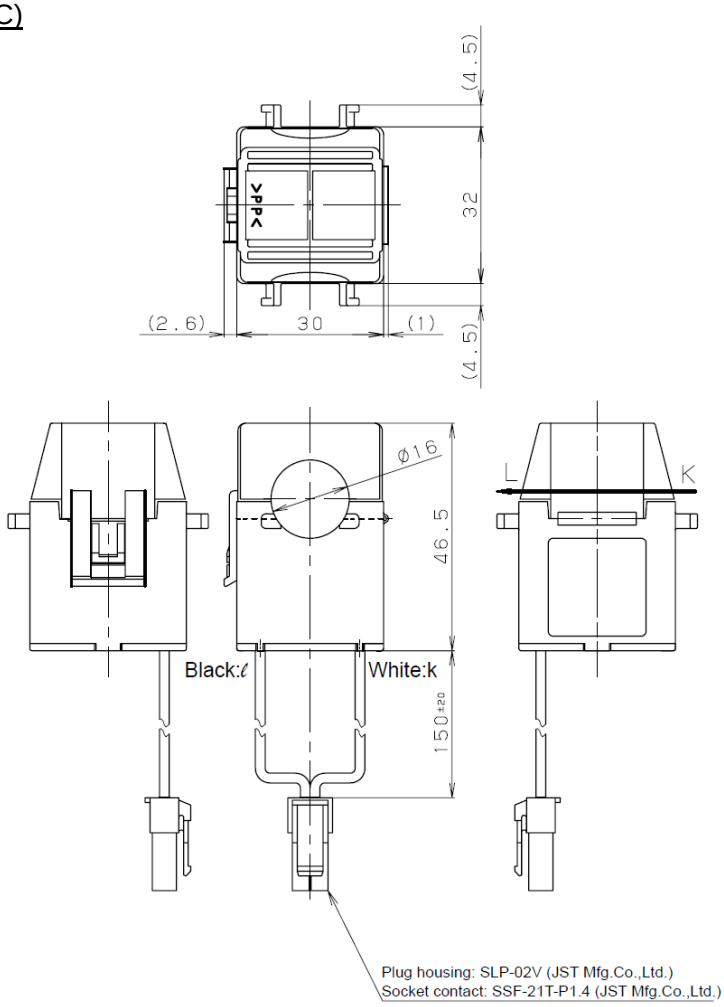


9.1.2 Dedicated CT

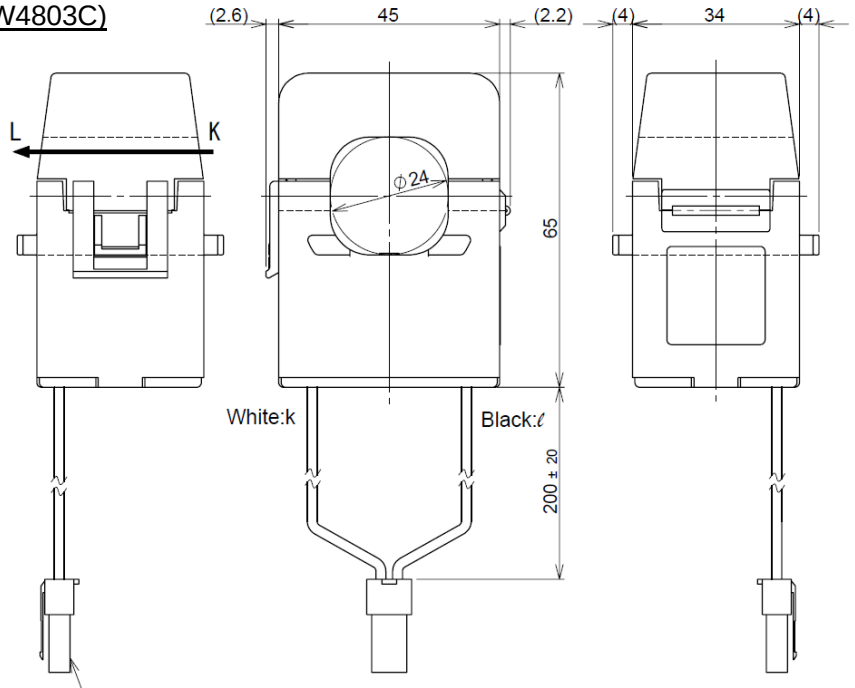
◆For 5A/50A (AKW4801C)



◆For 100A (AKW4802C)

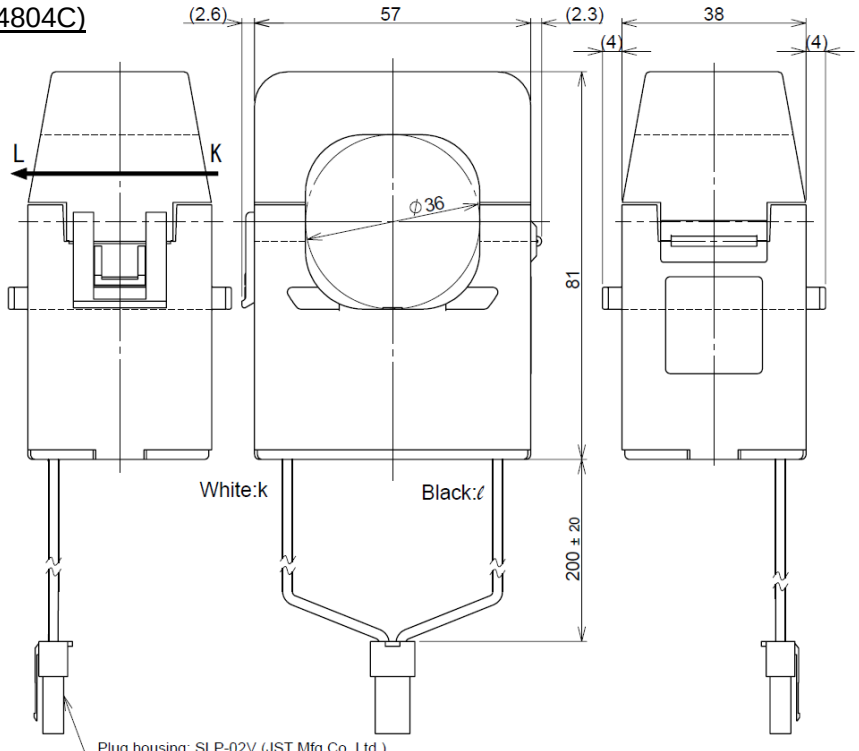


◆For 250A (AKW4803C)



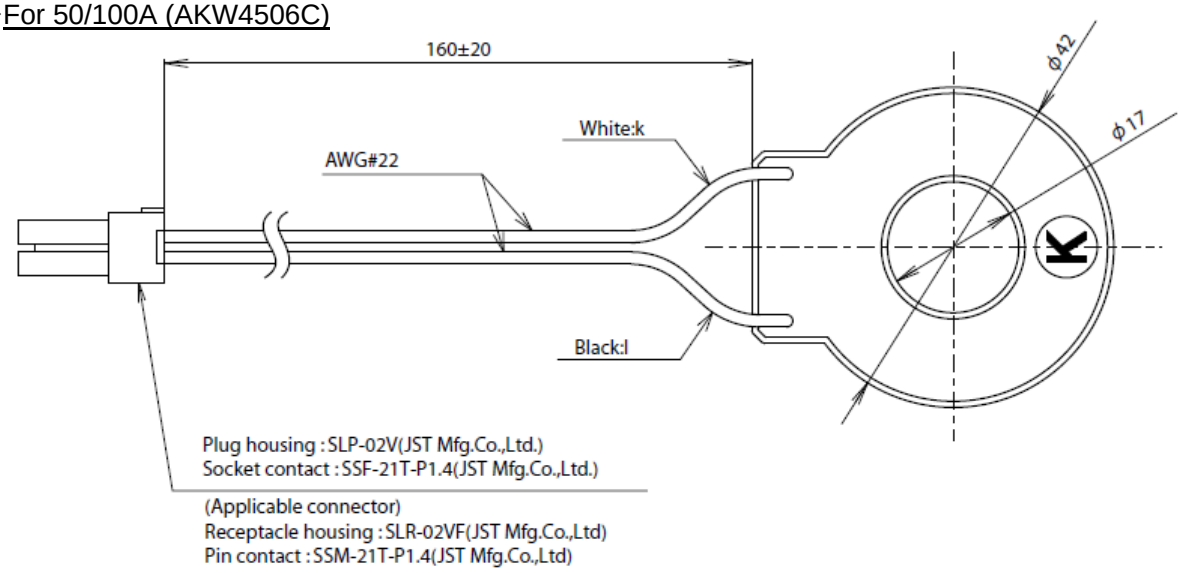
Plug housing: SLP-02V (JST Mfg.Co.,Ltd.)
Socket contact: SSF-21T-P1.4 (JST Mfg.Co.,Ltd.)
(Applicable connector)
Receptacle housing: SLR-02VF (JST Mfg.Co.,Ltd.)
Pin contact: SSM-21T-P1.4 (JST Mfg.Co.,Ltd.)

◆For 400A (AKW4804C)

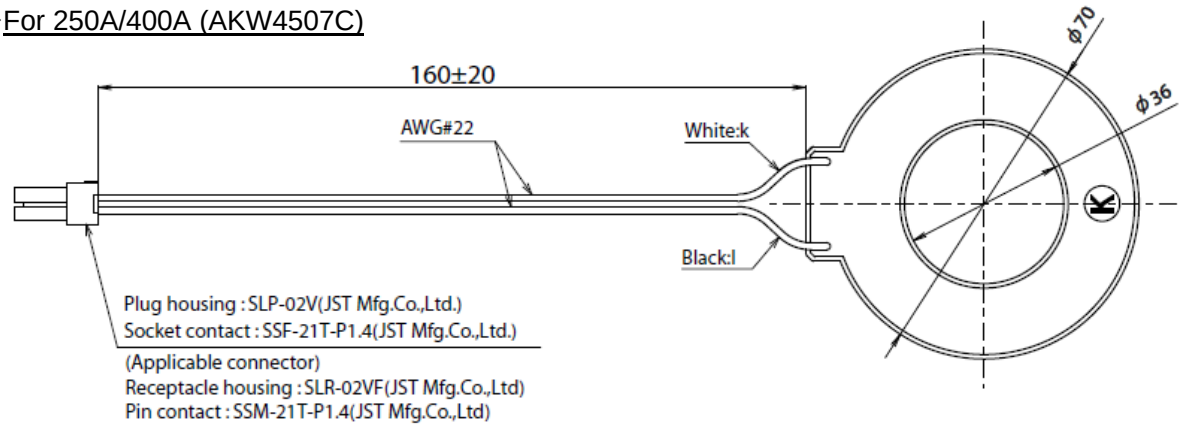


Plug housing: SLP-02V (JST Mfg.Co.,Ltd.)
Socket contact: SSF-21T-P1.4 (JST Mfg.Co.,Ltd.)
(Applicable connector)
Receptacle housing: SLR-02VF (JST Mfg.Co.,Ltd.)
Pin contact: SSM-21T-P1.4 (JST Mfg.Co.,Ltd.)

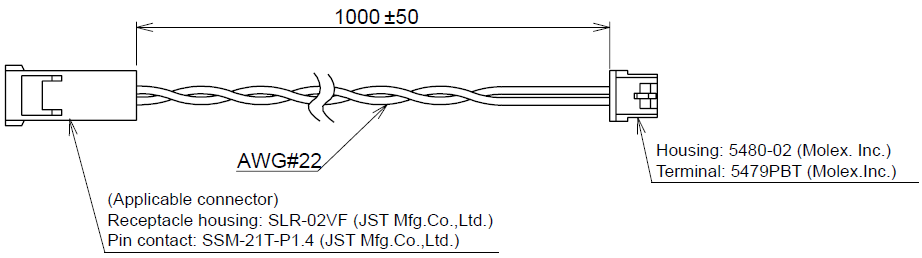
◆For 50/100A (AKW4506C)



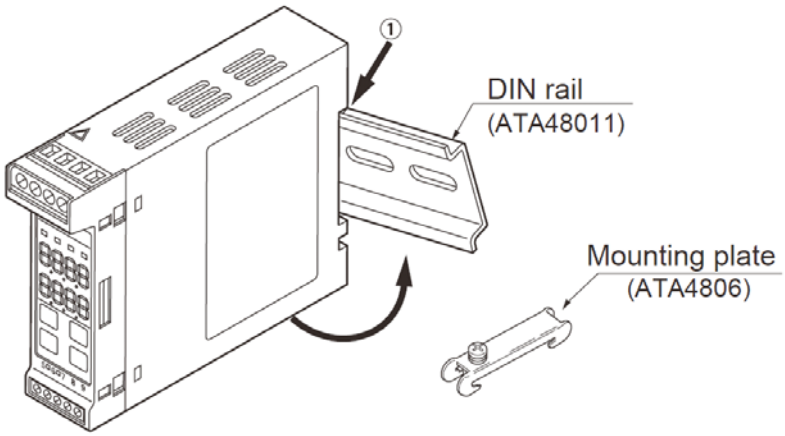
◆For 250A/400A (AKW4507C)



◆Attached trunk cable (common)



9.2 DIN rail mounting



(1) Hook A of main unit on the upper side of DIN rail.
(2) Making A part as a support, fit B the lower part of main unit to DIN rail.
(3) Main unit will be completely fixed to DIN rail with a “click” sound.

Revision History

Issue Date	Manual no.	Content of revision
July, 2007	ARCT1F434E	First edition
October, 2007	ARCT1F434E-1	Second edition 5-2 Wiring: Add the explanation in detail.
October, 2008	ARCT1F434E-2	Third edition ・Change company name
May, 2011	ARCT1F434E-3	4th edition Add functions ・Current alarm ・Stand-by alarm ・Add transmission speed "38400pbs" ・Change response time to "1 to 99ms"
January, 2012	ARCT1F434E-4	5th edition [Improve spec.] Improve the accuracy [Add functions] 600ACT input
July, 2013	ARCT1F434E-5	6th edition Company name change

Please contact .....

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Specifications are subject to change without notice.

ARCT1F434E-5